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181. a. 182.

PREFACE

THE following papers have been collected and used by the author in the course of tuition for some years past. They embrace the questions set in the most recent examinations conducted by the Civil Service Commissioners. With the help of the Rules which precede the papers a student will be able to use the book without a tutor. He is advised to work straight through a paper, omitting only those questions which he is unable to do, and he should not refer to the answers till he has completed the paper within the prescribed time.

Much care has been taken to test the accuracy of the answers, and it is hoped that the mistakes are few; any corrections from tutors or students will be thankfully received.

19, GARRICK STREET,
COVENT GARDEN, LONDON.

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TABLES OF WEIGHTS AND MEASURES.

I. MONEY.

4 farthings = 1 penny (*d.*)
12*d.* = 1 shilling (*s.*)
20*s.* = 1 pound (£)
21*s.* = 1 guinea.

960 farthings = 480 halfpence = 240*d.* = 80 threepenny pieces = 60 fourpenny pieces = 40 sixpences = 20*s.* = 10 florins = 8 half-crowns = 4 crowns = 2 half-sovereigns = £1.

ALIQUOT PARTS

of £1.	of 10*s.*	of 6*s.* 8*d.*	of 5*s.*	of 1*s.*
10*s.* is $\frac{1}{2}$	5*s.* is $\frac{1}{2}$	3*s.* 4*d.* is $\frac{1}{2}$	2*s.* 6*d.* is $\frac{1}{2}$	6*d.* is $\frac{1}{2}$
6*s.* 8*d.* is $\frac{1}{3}$	3*s.* 4*d.* is $\frac{1}{3}$	1*s.* 8*d.* is $\frac{1}{4}$	1*s.* 8*d.* is $\frac{1}{3}$	4*d.* is $\frac{1}{3}$
5*s.* is $\frac{1}{4}$	2*s.* 6*d.* is $\frac{1}{4}$	1*s.* 4*d.* is $\frac{1}{5}$	1*s.* 3*d.* is $\frac{1}{4}$	3*d.* is $\frac{1}{4}$
4*s.* is $\frac{1}{5}$	2*s.* is $\frac{1}{5}$	10*d.* is $\frac{1}{8}$	1*s.* is $\frac{1}{5}$	2*d.* is $\frac{1}{6}$
3*s.* 4*d.* is $\frac{1}{6}$	1*s.* 8*d.* is $\frac{1}{6}$	8*d.* is $\frac{1}{10}$	10*d.* is $\frac{1}{6}$	1½*d.* is $\frac{1}{8}$
2*s.* 6*d.* is $\frac{1}{8}$	1*s.* 3*d.* is $\frac{1}{8}$	4*d.* is $\frac{1}{20}$	7½*d.* is $\frac{1}{8}$	1*d.* is $\frac{1}{12}$
2*s.* is $\frac{1}{10}$	1*s.* is $\frac{1}{10}$		6*d.* is $\frac{1}{10}$	
1*s.* 8*d.* is $\frac{1}{12}$	10*d.* is $\frac{1}{12}$		5*d.* is $\frac{1}{12}$	
1*s.* 4*d.* is $\frac{1}{15}$	6*d.* is $\frac{1}{20}$		3*d.* is $\frac{1}{20}$	
1*s.* 3*d.* is $\frac{1}{16}$				
1*s.* is $\frac{1}{20}$				
8*d.* is $\frac{1}{30}$				
6*d.* is $\frac{1}{40}$				
4*d.* is $\frac{1}{60}$				
3*d.* is $\frac{1}{80}$				

II. TROY WEIGHT.

24 grains (grs.) = 1 pennyweight (dwt.)
20 dwts. = 1 ounce (oz.)
12 ozs. = 1 pound (lb.)
3$\frac{1}{6}$ grs. = 1 carat. 5760 grs. = 1 lb. Troy.
Pure gold is 24 carats fine.
Standard gold is 22 carats fine.

III. APOTHECARIES WEIGHT.

20 grains (grs.) = 1 scruple (scr.)
3 scr. = 1 dram (dr.)
8 drs. = 1 ounce (oz.)
12 ozs. = 1 pound (lb.)

The grain, ounce, and pound are the same as in Troy weight.

IV. AVOIRDUPOIS WEIGHT.

16 drams (dr.) = 1 ounce (oz.)
16 ozs. = 1 pound (lb.)
28 lbs. = 1 quarter (qr.)
4 qrs. = 1 hundredweight (cwt.)
20 cwt. = 1 ton.

112 lbs. = 1 cwt. 1 lb. Avoir. = 7000 grains Troy.
14 lbs. = 1 stone. 1 lb. Troy : 1 lb. Avoir. :: 144 : 175.

ALIQUOT PARTS OF A

ton.	cwt.	quarter.	pound.
10 cwt. is $\frac{1}{2}$	2 qrs. is $\frac{1}{2}$	14 lbs. is $\frac{1}{2}$	8 oz. is $\frac{1}{2}$
5 cwt. is $\frac{1}{4}$	1 qr. is $\frac{1}{4}$	7 lbs. is $\frac{1}{4}$	4 oz. is $\frac{1}{4}$
4 cwt. is $\frac{1}{5}$		4 lbs. is $\frac{1}{7}$	2 oz. is $\frac{1}{8}$
2 cwt. is $\frac{1}{10}$		$3\frac{1}{2}$ lbs. is $\frac{1}{8}$	1 oz. is $\frac{1}{16}$
1 cwt. is $\frac{1}{20}$		2 lbs. is $\frac{1}{14}$	
		1 lb. is $\frac{1}{28}$	

V. LINEAR MEASURE.

12 inches (ins.) = 1 foot (ft.)
3 ft. = 1 yard (yd.)
$5\frac{1}{2}$ yards = 1 rod, pole, or perch (po.)
40 po. = 1 furlong (fur.)
8 fur. = 1 mile (mi.)
3 mi. = 1 league (lea.)

4 ins. = 1 hand. 6 ft. = 1 fathom.
220 yds. = 1 furlong. 1760 yards = 1 mile.
60 geographical miles = $69\frac{1}{8}$ English miles = 1 degree.
360 degrees = the circumference of the globe.
100 links = 22 yards = 1 chain.

VI. CLOTH MEASURE.

2¼ inches (ins.) = 1 nail.
4 nails = 1 quarter (qr.).
4 qrs. = 1 yard (yd.).
3 qrs. = 1 Flemish ell.
5 qrs. = 1 English ell.
6 qrs. = 1 French ell.

VII. SQUARE MEASURE (Surface).

144 square inches (s. ins.) = 1 square foot (s. ft.)
9 s. ft. = 1 square yard (s. yd.)
30¼ s. yds. = 1 s. rod, pole, or perch (s. po.)
40 s. po. = 1 rood (ro.)
4 ro. = 1 acre.
640 acres = 1 square mile.
4840 s. yds. = 1 acre. 10000 s. links = 1 s. chain.
10 s. chains = 1 acre.

VIII. CUBIC MEASURE (Volume).

1728 cubic inches (cub. ins.) = 1 cubic foot (cub. ft.)
27 cub. ft. = 1 cubic yard (cub. yd.)

1 cub. ft. of pure water at a temperature of 62° Fahr. weighs 1000 oz. Avoir. nearly.

IX. LIQUID MEASURE.

4 gills = 1 pint (pt.)
2 pts. = 1 quart (qt.)
4 qts. = 1 gallon (gal.)

Beer.	Wine.
9 gals. = 1 firkin.	10 gals. = 1 anker.
18 gals. = 1 kilderkin.	18 gals. = 1 runlet.
36 gals. = 1 barrel.	42 gals. = 1 tierce.
54 gals. = 1 hogshead (hhd.)	63 gals. = 1 hogshead (hhd.)
2 hhds. = 1 butt.	84 gals. = 1 puncheon.
2 butts = 1 tun.	2 hhds. = 1 pipe.
	2 pipes = 1 tun.

The imperial gallon contains 277·274 cubic inches.

X. DRY MEASURE.

2 pints (pts.) = 1 quart (qt.)
4 qts. = 1 gallon (gal.)
2 gals. = 1 peck (pk.)
4 pks. = 1 bushel (bus.)
8 bus. = 1 quarter (qr.)

2 qts. = 1 pottle.
2 bus. = 1 strike.
2 strikes = 1 coomb.
5 qrs. = 1 load.
2 loads = 1 last.

XI. TIME.

60 seconds (sec.) = 1 minute (min.)
60 min. = 1 hour (hr.)
24 hrs. = 1 day.
7 days = 1 week (wk.)
52 weeks = 1 year.

28 days = 1 lunar month.
13 lunar months = 1 year.
12 calendar months = 1 year.
365 days = 1 ordinary year.
366 days = 1 leap year.

365 days 5 hours 48 minutes 47½ seconds nearly = 1 solar year.

XII. PAPER.

24 sheets = 1 quire.
20 quires = 1 ream.
2 reams = 1 bundle.

XIII.

12 articles = 1 dozen.
12 dozen = 1 gross.
20 articles = 1 score.

ARITHMETICAL RULES, DEFINITIONS,

ETC.

1. **Abstract numbers** have no reference to any particular unit, as 2, 3, 4, &c. In multiplication the multiplier must necessarily be an abstract number.

2. **Concrete numbers** have reference to some particular unit, as 2 apples, 3 tons, 4 pence, &c.

3. **A Prime number** is divisible only by itself and unity, and all **Primes** except 2 and 5 end in 1, 3, 7, or 9; but all numbers which end in 1, 3, 7, 9 are not necessarily Primes.

The Prime numbers below 100 are 1, 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97.

4. Numbers multiplied together form a **Product**, and they are called the **Factors** of the product; thus, 2 and 3 are factors of 6.

Another name for **Factor** is **Measure.**

5. To resolve a number into Prime factors is to find the prime numbers which, when multiplied together, will form the number.

6. **Composite** numbers are those which can be resolved into factors.

7. If a number be multiplied by itself any number of times, the products are called **Powers** of the number.

Thus 36 is the second power, or **Square** of 6, and is written 6^2.

216 is the third power, or **Cube** of 6, and is written 6^3.

1296 is the fourth power, and is written 6^4.

8. If a number measures several others, it is called a **Common Measure** of them; thus 7 is a common measure of 14, 49, and 63.

9. The **Greatest Common Measure** (G.C.M.) or **Highest Common Factor** (H.C.F.) of several numbers is the greatest number which measures each of them; thus 12 is the G.C.M. of 24 and 36.

10. A number is a **Multiple** of another number when the former exactly contains the latter; thus 6 is a multiple of 3.

11. A number is a **Common Multiple** of several numbers, when the former contains each of the latter; thus 12 is a common multiple of 2, 3, and 4.

12. The **Least Common Multiple** (L.C.M.) of several numbers is the least number which will contain each of them exactly; thus 12 is the L.C.M. of 2, 3, 4, and 6.

13. To read any number.

Mark off successive **periods** of three figures each from the right, and read each period from the left, giving the name of the period to the number expressed by the figures.

Ten hundreds = one thousand (1000); and the second period represents so many thousands.

A thousand thousand = one million (1,000,000); and the third period represents so many millions.

A million millions = one billion (1,000,000,000,000); and the fifth period represents so many billions.

(i.) Write down in words the number 806030075. (LXXXI. 1.)

806,030,075.

Eight hundred and six millions, thirty thousand and seventy-five.

(ii.) Write out in words 9000735006. (LXXX. 1.)

9,000,735,006.

Nine thousand millions, seven hundred and thirty-five thousands and six.

14. To test multiplication.

N.B.—Divide the sum of the digits of a number by 9, and set down the remainder. This is called "Casting out the nines."

(i.) Cast out the nines from the multiplier, multiplicand, and product separately, and set down the three remainders.

(ii.) Cast out the nines from the product of the first two remainders, and set down the remainder.

(iii.) If this last-found remainder is the same as the remainder left when the nines are cast out of the product, the sum is probably correct; if it is different, the sum is certainly wrong.

Multiply 940213 by 607004. (LXXX. 7.

$$\left.\begin{array}{r} 940213\ldots\ldots1 \\ 607004\ldots\ldots8 \end{array}\right\}8$$

$$\begin{array}{r} 607004 \\ \hline 3760852 \\ 658149100 \\ 56412780 \\ \hline 570713051852\ldots\ldots8. \end{array}$$

15. A number is divisible by

2 when the last digit is 0, or an even number.

3 when the sum of its digits is divisible by 3.

4 when the number formed by the last two digits is divisible by 4.

5 when the last digit is 0 or 5.

6 when it is even and divisible by 3.

8 when the number formed by the last three digits is divisible by 8.

9 when the sum of the digits is divisible by 9.

10 when the last digit is 0.

11 when the difference between the sum of the digits in the odd places, and the sum of the digits in the even places, is 0 or a multiple of 11.

12 when it is divisible by 3 and 4.

Thus the number 51480 is divisible by

2, because it is even.

3, because the sum of the digits (18) is divisible by 3.

4, because 80 is divisible by 4.

5, because the last digit is 0.

6, because it is even and divisible by 3.

8, because 480 is divisible by 8.

9, because 18 is divisible by 9.

10, because the last digit is 0.

11, because 0+4+5=8+1.
12, because it is divisible by 3 and 4.

16. To multiply by 5.

Annex a cypher, and divide the result by 2.

17. To multiply by 25.

Annex two cyphers, and divide the result by 4.

18. To multiply by 125.

Annex three cyphers, and divide the result by 8.

19. To multiply by 9.

Annex a cypher, and subtract the original number.

20. To multiply by 99.

Annex two cyphers, and subtract the original number. Similarly for 999, &c.

21. To multiply by 11.

(i.) For a number consisting of two digits.

Add the digits together, and place the sum between them. If the sum is more than 10, increase the left-hand digit by 1.

$$53 \times 11 = 583; \quad 78 \times 11 = 858.$$

(ii.) For any number.

Write down the units' digit, and from right to left add each digit to the next, adding in the figure carried, if any; and then bring down the left-hand digit, increasing it by 1, if 1 is carried. $78956 \times 11 = 868516.$

22. To multiply by any number from 12 to 19 in one line. Multiply by the figure in the unit's place of the multiplier, and to the number carried add the figure of the multiplicand last multiplied. (i.)

$$\begin{array}{r} 5624 \\ 17 \\ \hline 95608 \end{array}$$

(ii.) Multiply 32856 by 121711 in three lines of multiplication only. (XCI. 1.)

$$\begin{array}{r} 32856 \\ 121711 \\ \hline 361416 \\ 558552 \\ 394272 \\ \hline 3998936616 \end{array}$$

23. To divide by 5.

Multiply by 2, and cut off the last figure, taking one-half of this figure for the remainder.

24. To divide by 25.

Multiply by 4, and cut off two figures from the right, taking one-fourth of the number expressed by them for the remainder.

25. To divide by 125.

Multiply by 8, and cut off three figures from the right, taking one-eighth of the number expressed by them for the remainder.

26. To divide by a number which has two simple factors, neither of which exceed 12.

Divide first by one factor, and set down the remainder. Divide the quotient by the other factor, and set down the remainder.

For the complete remainder, multiply the first divisor by the last remainder, and add to the product the first remainder. Divide 78543 by 56.

$$56\left\{\begin{array}{l} 7)\underline{78543} \\ 8)\underline{11220} \end{array}\right. \quad \begin{array}{l} \\ \;\; - \; 3 \\ 1402 \; - \; 4 \end{array}\!\!\left.\begin{array}{l} \\ \\ \end{array}\right\} 31$$

See also § 64, Ex. 2.

27. To divide by a number which ends in cyphers.

Cut off as many figures from the right of the dividend as there are cyphers in the divisor. Divide by the remaining figures of the divisor; and for the remainder annex the figures cut off from the dividend to the number carried.

$$\begin{array}{l} 2,0)\underline{71859,3} \div 20 \\ \quad\; 35929 - 13. \end{array}$$

28. To find the G.C.M. of two numbers.

Divide the greater by the less; then the less number by the remainder; then the first remainder by the second; and so on, until there is no remainder. The last divisor is the G.C.M. (See §33.)

29. To find the G.C.M. of several numbers.

Resolve them into prime factors, and the G.C.M. is the product of the least powers of the factors which are common to all.

Find the G.C.M. of 8214, 1110, and 1702. **(XCIV. 3.)**

$$8214 = 2 \times 4107 = 2 \times 3 \times 1369 = 2 \times 3 \times 37^2$$
$$1110 = 2 \times 5 \times 111 = 2 \times 5 \times 3 \times 37$$
$$1702 = 2 \times 851 = 2 \times 37 \times 23$$
$$\therefore \text{ G.C.M.} = 2 \times 37 = 74.$$

30. To find the L.C.M. of several numbers.

Write the numbers in a line, and cancel any one which is contained in another. Divide by any prime number which is contained in two or more of them, placing the quotients in a new line, and bringing down the undivided numbers. Continue the process until you obtain a row in which there are no two numbers with a common measure. The product of all the divisors and the numbers in the last line will be the L.C.M.

Find the least number which is divisible by all the numbers up to 15 inclusive. **(XC. 2.)**

$$\begin{array}{r} 2\underline{)\cancel{1}, \cancel{2}, \cancel{3}, \cancel{4}, \cancel{5}, \cancel{6}, \cancel{7}, 8, 9, 10, 11, 12, 13, 14, 15} \\ 3\underline{)4, 9, \cancel{5}, 11, 6, 13, 7, 15} \\ 4, 3, \quad , 11, \cancel{2}, 13, 7, 5 \end{array}$$

$$\text{L.C.M.} = 2 \times 3 \times 4 \times 3 \times 11 \times 13 \times 7 \times 5 = 360360.$$

31. To find the L.C.M. of large numbers.

Resolve the numbers into their prime factors, and the L.C.M. will be the product of the highest powers of all the factors that occur.

Find the L.C.M. of 1836, 1482, 1938, and 8398. **(XCVII. 11.)**

$$1836 = 9 \times 204 = 3^2 \times 4 \times 51 = 3^2 \times 4 \times 3 \times 17 = 3^3 \times 2^2 \times 17$$
$$1482 = 2 \times 741 = 2 \times 3 \times 247 = 2 \times 3 \times 19 \times 13$$
$$1938 = 19 \times 102 = 19 \times 2 \times 51 = 19 \times 2 \times 3 \times 17$$
$$8398 = 2 \times 4199 = 2 \times 17 \times 247 = 2 \times 17 \times 19 \times 13$$
$$\therefore \text{ L.C.M.} = 3^3 \times 2^2 \times 17 \times 13 \times 19 = 453492.$$

32. Vulgar Fractions.

To show that $\frac{3}{5}=\frac{12}{20}$.

The fraction $\frac{3}{5}$ denotes that the unit (or whole) is divided into 5 equal parts, and 3 of these parts are taken.

The fraction $\frac{12}{20}$ denotes that the unit is divided into 20 equal parts, and 12 are taken. Now in the second fraction the unit has been divided into 4 times as many parts as in the first fraction; therefore each part is one quarter of its original size; but we take 4 times as many of such parts, and consequently obtain the same quantity as before.

$\therefore\ \frac{3}{5}=\frac{12}{20}$, and in the same way $=\frac{24}{40}=$&c.

Hence we infer that if the numerator and denominator of a fraction be multiplied or divided by the same number, the value of the fraction remains the same.

33. To reduce a fraction to its lowest terms; *i.e.* when the numerator and denominator are prime to each other.

Divide the numerator and denominator by any common factor; and if the factors cannot be found by the aid of rules §15, divide by the G.C.M. of the numerator and denominator.

Reduce to its lowest terms the fraction $\frac{8996427}{9078399}$. **(CIX. 2.)**

```
8996427)9078399(1
        8996427
        -------
        ..81972)8996427(109
                81972
                -----
                .799227
                 737748
                 ------
                 .61479)81972(1
                        61479
                        -----
                        20493)61479(3
                              61479
                              -----
                              ....
```

$\therefore\ \frac{8996427}{9078399}=\frac{20493}{20493}\times\frac{439}{443}=\frac{439}{443}$.

34. To reduce several fractions to equivalent fractions with their least common denominator.

Find the L.C.M. of the denominators, which will be the common denominator; divide this by each denominator, and multiply the quotient by the corresponding numerator. The results will be the new numerators.

35. To compare the values of fractions.

Reduce them to equivalent fractions having the same denominators, and compare the numerators of the new fractions.

Or, Reduce them to fractions having the same numerators, and compare the denominators.

36. Addition of Fractions.

(i.) Reduce improper fractions to mixed numbers, and add the whole numbers separately.

(ii.) Reduce the fractions to equivalent fractions with the least common denominator, and add the numerators.

Add together $1\frac{2}{3}$, $2\frac{3}{4}$, $3\frac{4}{5}$, and $4\frac{5}{6}$. (XIX. 1.)

$$\begin{aligned}\text{Sum} &= 10 + \frac{40+45+48+50}{60}\\ &= 10 + \tfrac{183}{60}\\ &= 10 + 3\tfrac{3}{60}\\ &= 13\tfrac{1}{20}.\end{aligned}$$

$$\begin{array}{l} 2\overline{)\cancel{3}\cdot 4\cdot 5\cdot 6} \\ \quad\; 2\cdot 5\cdot 3 \\ 2\times 2\times 5\times 3=60 \end{array}$$

N.B.—All compound fractions must be simplified, and all operations of multiplication and division must be performed before the addition.

Add together $3\frac{3}{4}$ of $\frac{5}{9}$, $\frac{11}{12}$ of $1\frac{2}{7}$, and $2\frac{1}{3}$ of $\frac{5}{7}$. (XL. 1.)

$$\frac{\overset{5}{\cancel{15}}}{4} \text{ of } \frac{5}{\underset{3}{\cancel{9}}} + \frac{11}{\underset{4}{\cancel{12}}} \text{ of } \frac{\overset{3}{\cancel{9}}}{7} + \frac{\cancel{7}}{3} \text{ of } \frac{5}{\cancel{7}}. \qquad (\S\ 38.)$$

$$\begin{aligned} &= \frac{25}{12} + \frac{33}{28} + \frac{5}{3}\\ &= 2\frac{1}{12} + 1\frac{5}{28} + 1\frac{2}{3}\\ &= 4 + \frac{7+15+56}{84}\\ &= 4 + \frac{78}{84}\\ &= 4\frac{13}{14}. \end{aligned}$$

$$\begin{array}{l} 4\overline{)12\,.\,28\,.\,\cancel{3}} \\ \quad\; 3\cdot\ 7 \\ 4\times 3\times 7=84 \end{array}$$

37. Subtraction of Fractions.

(i.) Subtract the whole numbers separately.

(ii.) Reduce the fractions to equivalent fractions with the least common denominator, and subtract the numerators. When the second fractional part is greater than the first, borrow 1 from the whole number, and add it to the less, then subtract.

(1) $20\frac{1}{8}-2\frac{1}{4}$ (I. 2.)

$$=18+\frac{1-2}{8}$$

$$=17+\frac{9-2}{8}$$

$$=17\frac{7}{8}.$$

(2) $10\frac{1}{19}-5\frac{3}{20}$ (I. 14.)

$$=5+\frac{20-57}{380}$$

$$=4+\frac{400-57}{380}$$

$$=4\frac{343}{380}.$$

38. Multiplication of Fractions.

(i.) Reduce all mixed numbers to improper fractions.

(ii.) Cancel any factors which are common to a numerator and denominator.

(iii.) Multiply the numerators that remain together, and the denominators that remain together, for the numerator and denominator of the resulting fraction.

A **compound fraction**, or a fraction *of* a fraction, is simplified by the process of multiplication.

$$\frac{13}{14}\times\frac{17}{35}\times\frac{17}{78}\times3\frac{3}{34}.$$ (XVII. 15.)

$$=\frac{\cancel{13}}{\underset{2}{\cancel{14}}}\times\frac{17}{\underset{7}{\cancel{35}}}\times\frac{\cancel{17}}{\underset{\underset{2}{\cancel{6}}}{\cancel{78}}}\times\frac{\overset{\overset{\cancel{3}}{\cancel{15}}}{\cancel{105}}}{\underset{2}{\cancel{34}}}$$

$$=\frac{17}{56}.$$

39. To multiply a fraction by a whole number.

Multiply the numerator, or divide the denominator.

40. To divide a fraction by a whole number.

Divide the numerator, or multiply the denominator.

41. Division of Fractions.

(i.) Reduce the mixed numbers to improper fractions.

(ii.) Invert the divisor, and multiply.

$$2\tfrac{5}{91} \div 15\tfrac{9}{13}. \qquad \text{(XVII. 16.)}$$

$$= \frac{187}{91} \div \frac{204}{13}$$

$$= \frac{\overset{11}{\cancel{187}}}{\underset{7}{\cancel{91}}} \times \frac{\cancel{13}}{\underset{12}{\cancel{204}}}$$

$$= \frac{11}{84}.$$

N.B.—When the divisor is a compound or complex fraction, it must be reduced to a simple fraction, and then inverted.

42. In simplifying a **complex** fraction, continue the work, step by step, as a whole.

$$1\tfrac{5}{6} \text{ of } \frac{\frac{1}{2} + 1\frac{1}{12} + \frac{1}{4}}{2\frac{1}{2} - 3\frac{1}{3} + 4\frac{1}{4}} \times \frac{\dfrac{2\frac{1}{2}}{3\frac{1}{7}} + \dfrac{\frac{3}{16}}{1\frac{3}{8}}}{\dfrac{3}{4\frac{1}{2}} + \dfrac{4\frac{1}{2}}{3}}. \qquad \text{(XCI. 3.)}$$

$$= \frac{11}{6} \text{ of } \frac{1 + \dfrac{6+1+3}{12}}{3 + \dfrac{6-4+3}{12}} \times \frac{\dfrac{5}{2} \times \dfrac{7}{22} + \dfrac{3}{\underset{2}{\cancel{16}}} \times \dfrac{\cancel{8}}{11}}{\cancel{3} \times \dfrac{2}{\underset{3}{\cancel{9}}} + \dfrac{\cancel{9}}{2} \times \dfrac{1}{\cancel{3}}}$$

$$= \frac{11}{6} \text{ of } \frac{1\frac{10}{12}}{3\frac{5}{12}} \times \frac{\frac{35}{44} + \frac{3}{22}}{\frac{2}{3} + \frac{3}{2}}$$

$$= \frac{11}{6} \text{ of } \frac{11}{6} \times \frac{12}{41} \times \frac{\dfrac{35+6}{44}}{\dfrac{4+9}{6}}$$

$$= \frac{11}{6} \text{ of } \frac{11}{6} \times \frac{12}{41} \times \frac{\dfrac{41}{44}}{\dfrac{13}{6}}$$

$$= \frac{\cancel{11}}{\underset{2}{\cancel{6}}} \times \frac{11}{\cancel{6}} \times \frac{\overset{3}{\cancel{12}}}{\cancel{41}} \times \frac{\cancel{41}}{\underset{4}{\cancel{44}}} \times \frac{\cancel{6}}{13}$$

$$= \frac{11}{26}.$$

43. In simplifying a **continued** fraction, simplify the lowest part of the denominator, and work up through the whole fraction till the last step is reached.

$$\cfrac{1}{2+\cfrac{1}{2+\cfrac{1}{2+\frac{1}{2}}}} \qquad \textbf{(XO. 5.)}$$

$$=\cfrac{1}{2+\cfrac{1}{2+\cfrac{1}{\frac{5}{2}}}}=\cfrac{1}{2+\cfrac{1}{2+\frac{2}{5}}}=\cfrac{1}{2+\cfrac{1}{\frac{12}{5}}}=\cfrac{1}{2+\frac{5}{12}}=\cfrac{1}{\frac{29}{12}}=\frac{12}{29}.$$

44. **Decimal Fractions.**

In decimal fractions the digit immediately following the decimal point represents **tenths,** the second digit **hundredths,** the third digit **thousandths,** and so on. Thus $12\cdot345=2+10+\frac{3}{10}+\frac{4}{100}+\frac{5}{1000}=12\frac{345}{1000}$; $\cdot002=\frac{2}{1000}$.

45. Cyphers annexed to a decimal have no effect on its value; thus $\cdot2=\cdot20=\cdot200$, &c.

Each cypher placed between the point and the decimal diminishes it tenfold; thus $\cdot02$ is $\frac{1}{10}$ of $\cdot2$.

46. To multiply a decimal by 10, 100, 1000, &c.

Remove the point 1, 2, 3, &c., places to the right.

47. To divide a decimal by 10, 100, 1000, &c.

Remove the point 1, 2, 3, &c., places to the left.

48. **Addition of Decimals.**

Place the numbers under each other, so that the points are all in a vertical line; *i.e.* all figures which have the same relative value are in the same vertical line.

Add as in whole numbers, keeping the point in the same vertical line.

$$\begin{array}{r@{\cdot}l} 16 & 41215 \\ 9 & 376 \\ & 00403 \\ 270 & 3 \\ \hline 296 & 09218. \end{array} \qquad \textbf{(I. 5.)}$$

49. Subtraction of Decimals.

Place the lesser number under the greater, with the points in the same vertical line.

Subtract as in whole numbers, and keep the point in the same vertical line.

If the number of decimal places in the lower line be more than in the upper line, annex cyphers to the upper line till the number of decimal places is the same.

(XIV. 6.)

$$\begin{array}{r} 121{\cdot}076800 \\ 48{\cdot}398675 \\ \hline 72{\cdot}678125 \end{array}$$

50. Multiplication of Decimals.

Multiply as in whole numbers, disregarding the point, and mark off from the right of the product as many decimal places as there are in the multiplier and multiplicand together, *prefixing* cyphers if there are not enough figures in the product.

Multiply together ·01, 6·59, and ·00053. (XVIII. 20.)

$$\begin{array}{r} 6{\cdot}59 \\ {\cdot}00053 \\ \hline 1977 \\ 3295 \\ \hline {\cdot}0034927 \\ {\cdot}01 \\ \hline {\cdot}000034927 \end{array}$$

51. Division of Decimals.

(i.) Take away the point from the divisor, and move the point in the dividend as many places to the right as there were decimal places in the divisor.

(ii.) Proceed as in division of whole numbers, and place the point in the quotient when you arrive at it in the division, any number of cyphers being annexed to the dividend if required for carrying on the division.

N.B.—Be careful to place a cypher in the quotient for every figure after the decimal point in the dividend before the actual division begins.

(I.) ·234)129·87((**XIX.** 21.)
234)129870·0(555
1170
·1287
1170
·1170
1170

(II.) 888)4·9284(·00555 (**XV.**22.)
4 440
·4884
4440
·4440
4440

(III.) ·81)·015267((**XVIII.** 21.)
81)1·5267(

$$81\left\{\begin{array}{l}9)\cdot16963\ldots\\ 9\ \cdot01884\ldots\end{array}\right.$$

52. To reduce a decimal to a vulgar fraction.

For the numerator: Write down the figures after the point.

For the denominator: Write 1, followed by as many cyphers as there are decimal places in the decimal.

53. To reduce a vulgar fraction to a decimal.

Bring down the numerator, followed by a point, and as many cyphers as may be necessary. Divide by the denominator as in division of decimals.

54. (i.) If the denominator of a vulgar fraction, expressed in its lowest terms, contains only powers of 2 and 5, or either of them, the decimal will terminate: $\frac{3}{4}=\frac{75}{100}=\cdot75$, $\frac{5}{8}=\frac{625}{1000}=\cdot625$.

(ii.) If the denominator contains no factors of 2 or 5, the decimal will be a **pure circulator**; *i.e.* the figures will recur from the beginning, immediately after the point: $\frac{1}{7}=\cdot\dot{1}4285\dot{7}$.

(iii.) If the denominator contains factors of 2 or 5, and also other factors, the decimal will be a **mixed circulator**; *i.e.* the recurring part will be preceded by figures which do not recur: $\frac{1}{48}=\cdot0208\dot{3}$.

N.B.—The number of figures that recur cannot be more than *one less* than the denominator.

$\frac{1}{7}$ has six figures in the *period*, or recurring part $=\cdot\dot{1}4285\dot{7}$.

$\frac{1}{19}$ has eighteen figures $=\cdot\dot{0}5263157894736842\dot{1}$.

$\frac{1}{37}$ has only three figures $=\cdot\dot{0}2\dot{7}$.

55. Note the following:

$$\tfrac{1}{7}=\cdot\dot{1}4285\dot{7}.$$

The fractions $\frac{2}{7}$, $\frac{3}{7}$, $\frac{4}{7}$ . . . . contain each the same recurring figures in the same order, beginning in each case with the second, third, fourth, &c., largest of the figures respectively;

i.e. $\tfrac{2}{7}=\cdot\dot{2}8571\dot{4}$, $\tfrac{3}{7}=\cdot\dot{4}2857\dot{1}$,
$\tfrac{4}{7}=\cdot\dot{5}7142\dot{8}$, $\tfrac{5}{7}=\cdot\dot{7}1428\dot{5}$,
$\tfrac{6}{7}=\cdot\dot{8}5714\dot{2}$. (See CVIII. 18.)

56. To reduce a pure circulating decimal to a vulgar fraction.

For the numerator: Write down the decimal.

For the denominator: Write down as many *nines* as there are figures in the period.

Reduce the fraction to its lowest terms.

$$1\cdot\dot{2}\dot{4}=1\frac{24}{99}=1\frac{8}{33}.$$

57. To reduce a mixed circulating decimal to a vulgar fraction.

For the numerator: From the whole decimal subtract the number formed by the figures which do not recur.

For the denominator: Write as many nines as there are recurring figures, followed by as many cyphers as there are figures which do not recur.

$$1\cdot 10\dot{3}\dot{1}=1\frac{1031-10}{9900}=1\frac{1021}{9900}. \qquad \text{(C. 1.)}$$

58. Similar circulating decimals contain the same number of recurring and of non-recurring figures.

$\cdot 00\dot{1}2\dot{3}$, $3\cdot 45\dot{6}7\dot{8}$ are similar.

59. To make circulating decimals similar.

Make the number of non-recurring figures in each the same as in that which has the greatest number.

Make the number of recurring figures in each equal to the L.C.M. of the numbers of recurring figures in the several decimals.

$$2\cdot 45\dot{6}7\dot{8}=2\cdot 456\dot{7}8678\dot{6}.$$
$$3\cdot 567\dot{8}\dot{9}=3\cdot 567\dot{8}9898\dot{9}.$$

60. Addition of circulating decimals.

Make the decimals similar, and add: to the right-hand column of the similar periods add the number carried from the left-hand column of the periods.

$$\begin{array}{rr} 7\cdot07\dot{6} = & 7\cdot07\dot{6}66666\dot{6} \\ 19\cdot\dot{2}4\dot{5} = & 19\cdot24\dot{5}2452\dot{4} \\ 18\cdot2\dot{0}\dot{3} = & 18\cdot20\dot{3}0303\dot{0} \\ \hline & 44\cdot52\dot{4}94220 \\ & 1 \\ \hline & 44\cdot52\dot{4}9422\dot{1} \end{array}$$

(CX. 4.)

61. Subtraction of circulating decimals.

Make the decimals similar, and subtract: if 1 is carried from the right-hand column of the similar periods, subtract 1 from the right-hand figure of the result.

62. Multiplication and division of circulating decimals are best performed by converting the decimals into vulgar fractions, and proceeding as in vulgar fractions; then express the result as a decimal.

$$\begin{aligned} & 91\cdot\dot{8}6\dot{3} \div 87\cdot5\dot{6} \\ & = 91\frac{863}{999} \div 87\frac{51}{90} \\ & = \frac{91772}{999} \div \frac{7881}{90} \\ & = \frac{91772}{\underset{111}{\cancel{999}}} \times \frac{\overset{10}{\cancel{90}}}{7881} = \frac{917720}{874791} = 1\cdot0490734\ldots \end{aligned}$$

(LXXXIX. 8.)

63. Reduction.

To reduce a higher denomination to a lower.

Multiply the highest denomination by the number of times the next lower denomination is contained in it, adding in the number of this lower denomination, if any; and continue the process for each succeeding denomination till the required one is obtained.

(I.) Reduce 1 mile 3 furlongs 10 poles 2 feet to feet.

(XXXIII. 19.)

$$\begin{array}{rl}
1 & \\
8 & \\ \hline
11 & \text{furlongs.} \\
40 & \\ \hline
450 & \text{poles.} \\
5\frac{1}{2} & \\ \hline
2250 & \\
225 & \\ \hline
2475 & \text{yards.} \\
3 & \\ \hline
7427 & \text{feet.}
\end{array}$$

(II.) Reduce 1 acre 2 roods 11 per. 3 yards to square inches.

(LVI. 14.)

$$\begin{array}{rl}
4 & \\ \hline
6 & \text{roods.} \\
40 & \\ \hline
251 & \text{perches.} \\
30\frac{1}{4} & \\ \hline
7533 & \\
62\frac{3}{4} & \\ \hline
7595\frac{3}{4} & \text{yards.} \\
9 & \\ \hline
68361\frac{3}{4} & \text{feet.} \\
\left.\begin{array}{r} 12 \\ \hline 820341 \\ 12 \end{array}\right\} & 144 \\ \hline
9844092 & \text{square inches.}
\end{array}$$

64. To reduce a lower denomination to a higher.

Divide the quantity by the number of times its denomination is contained in the next higher, and write down the remainder, which is of the same denomination as the dividend. Continue the process until the required denomination is obtained.

(I.) In 3706529 inches, how many miles, furlongs, poles, &c., are there? (III. 10.)

inches.
12)3706529
3)308877 — 5 inches.
102959 — 0 feet.
2
11)205918 half-yards.
40)18719 — 9 half-yards = 4½ yards.
8)467 — 39 poles.
58 — 3 furlongs.

Ans. 58 miles 3 furlongs 39 poles 4½ yards 5 inches; or, since ½ yard = 1 foot 6 inches,
58 miles 3 furlongs 39 poles 4 yards 1 ft. 11 in.

(II.) In 57625318 square inches, how many acres, roods, &c.? (III. 22.)

144 { 12)57625318
12)4802109—10 } 118 square inches
9)400175—9 }
44463—8 square feet
4
121 { 11)177852 quarter yards
11)16168—4 } 103 quarter yards
40)1469—9 } = 25¾ yards
= 25 yards 6 feet 108 inches
4)36—29 poles
9—0 roods

9 acres 0 roods 29 poles 25 yards 6 feet 108 inches
8 feet 118 inches

Ans. 9 acres 0 roods 29 poles 26 yards 6 feet 82 inches

65. To find the value of a vulgar fraction of a concrete quantity.

Multiply the quantity by the numerator of the fraction, and divide by the denominator.

If the fraction be a mixed number, multiply first by the whole number, and then find the fraction of the quantity, and add the results together.

$$\begin{array}{rrrr} & \pounds & s. & d. \\ \tfrac{7}{11} \text{ of} & 2 & 6 & 9 \\ & & & 7 \\ \hline 11)\!\!\!\! & 16 & 7 & 3 \\ \hline & 1 & 9 & 9 \end{array}$$

(CXVI. 6.)

66. To reduce one quantity (or a fraction of one quantity) to a fraction of another quantity of the same kind.

Reduce both to the same denomination, and write the first quantity for the numerator and the second for the denominator, and reduce the resulting fraction to its lowest terms.

Reduce £7 18*s.* 8½*d.* to the fraction of £27 15*s.* 5¾*d.* in its lowest terms. **(CXVIII. 6.)**

$$\frac{\overset{\pounds}{7}\ \overset{s.}{18}\ \overset{d.}{8\tfrac{1}{2}}}{27\ 15\ 5\tfrac{3}{4}} = \frac{7618 \text{ farthings}}{26663 \text{ farthings}} = \frac{3809 \times 2}{3809 \times 7} = \frac{2}{7}$$

67. To find the value of a decimal of a concrete quantity, or to multiply a concrete quantity by a decimal.

Multiply the quantity by the decimal, and mark off from the right of the product the same number of decimal places as in the multiplier. Reduce the decimal part to the next lower denomination, marking off as before; and so on. The figures on the left of the point will be the whole numbers in the next denomination.

Find the value of 2·003125 of £8. **(LVIII. 13.)**

$$\begin{array}{r} 8 \\ \hline \pounds 16{\cdot}025\cancel{0}\cancel{0}\cancel{0} \\ 20 \\ \hline s.\,0{\cdot}5\cancel{0}\cancel{0} \\ 12 \\ \hline d.\,6{\cdot}0 \end{array}$$

Ans. £16 0*s.* 6*d.*

68. To reduce a concrete quantity of several denominations to a decimal of another of the same kind of one denomination.

Bring down the lowest denomination, followed by a point and as many cyphers as is necessary. Divide by the number of times this denomination is contained in the next higher, prefixing as a whole number the quantity of next higher denomination. Continue the process till the required denomination is obtained.

(I.) Express £2 3*s.* 7½*d.* as the decimal of £5.

12)7·5 pence **(XXXVII. 9)**

20)3·625 shillings

5)2·18125 £

·43625 Ans.

(II.) Reduce 3 furlongs 5 poles 2¾ yards to the decimal of a mile. **(LV. 39.)**

2¾ yards is ½ of 5½ yards, and ∴ = ½ a pole.

40)5·5 pole.

8)3·1375 furlong.

·392187 5 mile.

69. To reduce a concrete quantity of several denominations to a decimal of another quantity of the same kind also of several denominations.

Reduce both to the same denomination, and divide the first by the second, as in division of decimals.

Express 12 ounces 8 drams as the decimal fraction of 2 cwt. 26 lbs. **(XXXVI. 9.)**

$$\frac{\text{12 oz. 8 dr.}}{\text{2 cwt. 26 lbs.}}=\frac{2\cancel{0}\cancel{0}\text{ dr.}}{640\cancel{0}\cancel{0}\text{ dr.}}=\frac{1}{320}=\cdot003125.$$

70. Practice.

In **Simple Practice** we find the value of any number of articles of the same kind when the value of one is given.

Multiply the number of articles by the number of pounds, and take aliquot parts for the shillings and pence, and add the results together.

(I.) Find the cost of 12480 things at £3 7*s.* 5¼*d.* each.

12480 **(XXXVI. 20.)**

3

		37440	price at £3 each.
6*s.* 8*d.*	$\frac{1}{3}$	4160	„ 6*s.* 8*d.* each.
8*d.*	$\frac{1}{10}$	416	„ 8*d.* „
1*d.*	$\frac{1}{8}$	52	„ 1*d.* „
¼*d.*	$\frac{1}{4}$	13	„ ¼*d.* „
		£42081	price at £3 7*s.* 5¼*d.* each.

(II.) Find the dividend on £5476 10*s.* at 13*s.* 6*d.* in the pound. **(XXXIX. 13.)**

		£	*s.*		
		5476	10		= dividend at £1 in £.
10*s.*	$\frac{1}{2}$	2738	5		„ 10*s.* in £.
2*s.* 6*d.*	$\frac{1}{4}$	684	11	3	„ 2*s.* 6*d.* „
1*s.*	$\frac{1}{10}$	273	16	6	„ 1*s.* „
		3696	12	9	„ 13*s.* 6*d.* „

71. In **Compound Practice** we find the value of any quantity consisting of several denominations, when the value of a single unit is given.

Multiply the price by the highest denomination, and take aliquot parts for the lower denominations, and add the results together.

Find the value of 1 ton 5 cwt. 2 qrs. 7 lbs. at £3 per ton. **(LIV. 16.)**

		£	*s.*	*d.*	
		3	....		price of 1 ton.
5 cwt.	$\frac{1}{4}$	-	15......		„ 5 cwt.
2 qrs.	$\frac{1}{10}$	-	1	6	„ 2 qrs.
7 lbs.	$\frac{1}{8}$	-	-	2¼	„ 7 lbs.
		3	16	8¼	price of 1 ton 5 cwt. 2 qrs. 7 lbs.

72. Proportion or Rule of Three.

Ratio is the relation which one quantity bears to another of the same kind in respect of magnitude, the comparison being made by considering how many times the one is contained in the other.

The two numbers forming the ratio are called the **terms,** and they correspond to the numerator and denominator of a fraction. Thus, if A has 3*s.* and B has 4*s.*, the ratio of their money is as 3*s.* to 4*s.*, or as the abstract numbers 3 to 4 (3 : 4); so that A has three-fourths of what B has.

73. **Ratios** may be compared by comparing the fractions by which they are represented.

74. **Proportion** is the equality of two ratios; so that the two fractions representing the ratios are equal; and when the first three terms of a proportion are given, the fourth may be found according to the following rule.

(i.) Place the quantity which corresponds to the answer in the third term; if it consists of several denominations, reduce it to the lowest denomination.

(ii.) Place the greater or less of the other two quantities in the second term, according as, from the nature of the question, the answer is greater or less than the third term.

(iii.) Place the remaining quantity in the first term, and reduce the first and second terms to the same denomination, and consider them as abstract numbers.

(iv.) Cancel, if possible, the first and second terms, or the first and third terms.

(v.) Multiply the second and third terms together, and divide the product by the first term, and the resulting answer will be of the same denomination as the third term.

If 3½ lbs. of sugar cost 1*s.* 10¾*d.*, how much may be bought for £9 9*s.* 7*d.*? (LVII. 2)

Ans. "more," therefore the greater for the second term.

$$
\begin{array}{lrlrlrl}
 & \textit{s.}\ \ \textit{d.} & & \text{£}\ \ \textit{s.}\ \ \textit{d.} & & \text{lbs.} & \\
\text{As} & 1\ \ 10\tfrac{3}{4} & : & 9\ \ 9\ \ 7 & :: & 3\tfrac{1}{2} & : \text{Ans.} \\
 & 12 & & 20 & & & \\
 & \overline{22} & & \overline{189} & & & \\
 & 4 & & 12 & & & \\
 & \overline{\cancel{91}} & & \overline{2275} & & & \\
 & & & 4 & & & \\
 & & & \overline{\cancel{9100}} & & & \\
 & & & 100 & & & \\
 & & & 3\tfrac{1}{2} & & & \\
 & & & \overline{300} & & & \\
 & & & 50 & & & \\
 & & & \overline{350\ \text{lbs.}} & & &
\end{array}
$$

75. Double Rule of Three, or Compound Proportion.

We have several pairs of quantities of like kind, and one odd quantity, which is of the same kind as the answer.

(i.) Place this odd quantity in the third term.

(ii.) Take the pairs separately, and consider each pair with the third term as in simple proportion, disregarding all the quantities except the pair under consideration.

Reduce (if necessary) each pair to the same denomination.

(iii.) Cancel any numbers in the first and second terms, or in the first and third terms.

(iv.) The product of all the numbers left in each term will form the terms of a simple proportion.

(I.) If 2 horses can plough 7 acres of ground in a day, how many horses will be required to plough 161 acres in 11½ days? (I. 26.)

The odd term, 2 horses, is the third term. If 2 horses can plough 7 acres, how many will be required to plough 161? More, ∴ 7 : 161.

If 2 horses can plough acres in 1 day, how many will be required to plough the same acres in 11½ days? Less, ∴ 11½ : 1, or 23 : 2.

$$\begin{array}{rcccccl}
 & \cancel{7} & & \cancel{161}\ \cancel{23} & & \text{Horses.} & \\
 & \underline{\cancel{23}} & & \underline{2} & & \underline{2} & \\
\text{As} & 1 & : & 2 & :: & 2 & : \text{Ans.} \\
 & & & \underline{2} & & & \\
 & & \text{Ans.} & 4 & \text{horses.} & &
\end{array}$$

(II.) If the *4d.* loaf weighs 10 oz. when wheat is 63*s.* a quarter, what would be the weight of the *2d.* loaf when wheat is 54*s.* a quarter? (LXI. 28.)

Place 10 oz. in the third term.

If the *4d.* loaf weighs 10 oz., what would be the weight of the *2d.* loaf?

Less, ∴ 4 : 2.

If a loaf weighs 10 oz. when wheat is 63*s*. a quarter, what should be the weight when wheat is 54*s*. a quarter?

More, ∴ 54 : 63.

We have then,

$$\begin{array}{rcccccl}
 & \cancel{2}\ \cancel{4} & & \cancel{2} & & \text{oz.} & \\
 & 6\ \underline{\cancel{5}\cancel{4}} & & \underline{\cancel{6}\cancel{3}}\ 7 & & \underline{\cancel{1}\cancel{0}}\ 5 & \\
\text{As} & 6 & : & 7 & :: & 5 & : \ \text{Ans.}
\end{array}$$

$$\begin{array}{r}
7 \\
\underline{5} \\
6)\underline{35} \\
5\tfrac{5}{6}\ \text{oz.} = \text{Ans.}
\end{array}$$

(III.) If 75 men can perform a piece of work in 12 days of 10 hours each, how many men will perform a piece of work twice as large in a tenth part of the time, if they work the same number of hours in the day, supposing that 2 of the second set can do as much work in an hour as 3 of the first set? **(LXXXIV. 12.)**

Place 75 men in the third term.

If 75 men can do 1 piece of work, how many will do 2 pieces? More, ∴ 1 : 2.

If 75 men can do it in 12 days, how many will do it in $\frac{1}{10}$ of 12 days? More, ∴ $\frac{1}{10}$: 1 or 1 : 10.

Now 2 of the second set = 3 of the first set.

∴ 1 of the second set = $\frac{3}{2}$ of the first set.

∴ each of the second set does $\frac{3}{2}$ (half as much again) of the work done by each of the first set.

∴ if 75 men can do it when each does 1 portion of work, how many will do it when each does $\frac{3}{2}$ portion?

Less, ∴ $\frac{3}{2}$: 1 or 3 : 2.

Hence we have,

$$\begin{array}{rcccccl}
 & 1 & & 2 & & \text{Men.} & \\
 & 1 & & 10 & & \cancel{75}\ 25 & \\
 & \underline{\cancel{3}} & & \underline{2} & & & \\
\text{As} & 1 & : & 40 & :: & 25 & : \ \text{Ans.} \\
 & & & \underline{25} & & & \\
 & & & 1000\ \text{men.} & & &
\end{array}$$

76. Simple Interest.

In all questions there are four quantities—the **principal**, or money lent; **time**; **rate per cent.**, or interest on £100 for one year; and **interest**—and when three are given, the fourth can be found.

The **amount** is the interest added to the principal.

(I.) Given the principal, time, and rate, find the interest.

Multiply the principal by (rate multiplied by number of years), and divide the result by 100.

Find the simple interest on £576 for 6 years at $4\frac{1}{2}$ per cent. per annum. (I. 12.)

$6 \times 4\frac{1}{2} = \overset{3}{\cancel{6}} \times \frac{9}{\cancel{2}} = 27.$

$$\begin{array}{r} £ \\ 576 \\ 27 \\ \hline 4032 \\ 1152 \\ \hline 155 \cdot 52 \\ 20 \\ \hline 10 \cdot 4\cancel{0} \\ 12 \\ \hline 4 \cdot 8 \end{array}$$

To divide by 100, cut off two figures from the right.

Ans. £155 10*s.* $4\frac{4}{5}$*d.*

(II.) Given the principal, rate, and interest, find the time.

In what time will £445 amount to £486 14*s.* $4\frac{1}{2}$*d.* at $2\frac{1}{2}$ per cent. per annum? (VI. 25.)

Or, in what time will £445 produce £41 14*s.* $4\frac{1}{2}$*d.* interest at $2\frac{1}{2}$ per cent. per annum?

$$\begin{array}{rrl} £ & s. & d. \\ 486 & 14 & 4\frac{1}{2} \\ 445 & 0 & 0 \\ \hline 41 & 14 & 4\frac{1}{2} = \text{interest to get.} \end{array}$$

$$\begin{array}{ll} £ & \\ 445 & \\ 2\frac{1}{2} & \\ \hline 890 & \\ 222 & 10 \\ \hline 11 \cdot 12 & 10 \\ 20 & \\ \hline 2 \cdot 5\cancel{0} & \\ 12 & \\ \hline 6 \cdot 0 & \end{array}$$

Or, since $2\frac{1}{2}$ per cent. $= \frac{1}{40}$

$$\begin{array}{l} 40)445 \\ \hline £11\ 2s.\ 6d. \end{array}$$

In one year I get £11 2*s*. 6*d*. In what time shall I get £41 14*s*. 4½*d*.?

$$\begin{array}{lrrrcrrrccl}
 & \pounds & s. & d. & & \pounds & s. & d. & & \text{year.} & \\
\text{As} & 11 & 2 & 6 & : & 41 & 14 & 4\frac{1}{2} & :: & 1 & : \text{ Ans.}
\end{array}$$

$$\begin{array}{rr}
20 & 20 \\ \hline
222 & 834 \\
12 & 12 \\ \hline
2670 & 10012 \\
2 & 2 \\ \hline
5340 &)20025(3 \\
 & \underline{16020} \\
 & \frac{4005}{5340}=\frac{3}{4}
\end{array}$$

Ans. $3\frac{3}{4}$ years.

In what time will £2220 be doubled at $3\frac{3}{4}$ per cent. simple interest? (See **LV.** 30.)

Interest required = £2220.

Interest for 1 year $=\frac{\pounds 2220\times 3\frac{3}{4}}{100}$

$$\therefore \text{ As } \overset{\pounds}{\cancel{2220}}\times\frac{3\frac{3}{4}}{100} : \overset{\pounds}{\cancel{2220}} :: \overset{\text{year.}}{1} : \text{Ans.}$$

$$\text{Ans.}=\frac{100}{3\frac{3}{4}}=\overset{20}{\cancel{100}}\times\frac{4}{\underset{3}{\cancel{15}}}=\frac{80}{3}=26\tfrac{2}{3}\text{ years.}$$

It is clear that the result is the same for any principal.

∴ Any sum of money will double itself at simple interest in $\frac{100}{\text{rate per cent.}}$ years.

(III.) Given the principal, time, and interest, find the rate per cent.

At what rate per cent. will £1315 amount to £1545 2*s*. 6*d*. in 2½ years? (**LII.** 30.)

Or, at what rate per cent. will £1315 produce £230 2*s*. 6*d*. interest in 2½ years?

$$\begin{array}{rrrl}
\pounds & s. & d. & \\
1545 & 2 & 6 & \\
1315 & 0 & 0 & \\ \hline
230 & 2 & 6 & =\text{interest required in } 2\frac{1}{2}\text{ years.} \\
 & & 2 & \\ \hline
5)460 & 5 & 0 & \\ \hline
92 & 1 & 0 & =\text{interest required in 1 year.}
\end{array}$$

If £92 1*s.* is the interest on £1315, what is the interest on £100?

$$\begin{array}{llllll}
 & \pounds & \pounds & \pounds & s. & \\
\text{As} & \cancel{1315} : & \cancel{100} :: & 92 & 1 : & \text{Ans.}\\
 & \cancel{263} & 20 & 20 & & \\
 & & \underline{7} & \overline{\cancel{1841}} & & \\
 & & 20)\underline{140} & 7 & & \\
 & & \pounds 7 & & & \text{Ans. 7 per cent.}
\end{array}$$

(IV.) Given the time, rate per cent., and interest, find the principal.

What principal is required to produce £225 1*s.* 6*d.* at 5 per cent. simple interest in 3 years? (VIII. 25.)

In 3 years, at 5 per cent., £100 produces £15. If £100 produces £15 interest, what sum will produce £225 1*s.* 6*d.*?

$$\begin{array}{llllll}
 & \pounds & \pounds\quad s.\quad d. & & \pounds & \\
\text{As} & 15 \quad : & 225\quad 1\quad 6 & :: & \cancel{100} : & \text{Ans.}\\
 & \underline{20} & \underline{20} & & & \\
 & 300 & 4501 & & & \\
 & \underline{2} & \underline{2} & & & \\
 & 6\cancel{00} & 6)\underline{9003} & & & \\
 & & 1500\quad 10 & & & \text{Ans. } \pounds 1500\ 10s.
\end{array}$$

The question might be put thus:

What sum of money will amount to £1725 11*s.* 6*d.* at 5 per cent. simple interest in 3 years?

In 3 years, at 5 per cent., £100 amounts to £115. If £100 amounts to £115, what sum will amount to £1725 11*s.* 6*d.*?

$$\begin{array}{llllll}
 & \pounds & \pounds\quad s.\quad d. & & \pounds & \\
\text{As} & \cancel{115} : & 1725\quad 11\quad 6 & :: & \cancel{100} : & \text{Ans.}\\
 & 23 & \qquad\qquad\ \ 20 & & 20 & \\
 & & \overline{)34511\quad 10\quad 0(\pounds 1500} & & & \\
 & & \underline{115} & & & \\
 & & \ldots 11 & & & \\
 & & \quad\ \underline{20} & & & \\
 & & 23)230(10 & & & \\
 & & \ldots & & & \text{Ans. } \pounds 1500\ 10s.
\end{array}$$

77. Compound Interest.

In compound interest the interest each year is added to the principal, and the amount becomes the principal for the next year. It is generally best to work by decimals throughout, moving the point two places to the left, after multiplying by the rate, for the division by 100.

When the interest is required for any number of years, and a fraction of a year, find the interest for the whole of the last year, and then take the fractional part of it, adding this to the last principal.

If the interest is payable half-yearly, double the time and halve the rate, and work as before; this is evident, as 5 per cent. for 2 years, payable half-yearly, is the same as 2½ per cent. for 4 half-years.

So again, if the interest is payable quarterly, take 4 times the time and ¼ of the rate.

In all cases the compound interest is the difference between the last amount and the original principal.

(I.) Find the amount of £1485 in 3 years at 5 per cent. compound interest. (LII. 17.)

£
1485
5
74·25 = 1st interest.
1485·
1559·25 = amount at end of first year.
5
77·9625 = 2nd interest.
1559·25
1637·2125 = 2nd amount.
5
81·860625 = 3rd interest.
1637·2125
1719·073125 = 3rd amount.
20
$1{\cdot}4625\cancel{0}\cancel{0}$
12
$5{\cdot}55\cancel{0}\cancel{0}$

Since 5 per cent. is $\frac{1}{20}$, we might work thus:

£
1485
$\frac{1}{20}$ 74·25
1559·25
$\frac{1}{20}$ 77·9625
1637·2125
$\frac{1}{20}$ 81·860625
1719·073125
...etc....etc.

N.B. 2½ per cent. is $\frac{1}{40}$.
10 per cent. is $\frac{1}{10}$.

	£	s.	d.
Amount =	1719	1	$5\frac{11}{20}$.
	1485		
Compound int. =	234	1	$5\frac{11}{20}$.

(II.) Find the difference between the simple and compound interest of £365 4*s.* 8$\frac{1}{4}$*d.* for 3 years at 4 per cent. (CVI. 11.)

12)8·25

20)4·6875

£365·234375

4

14·609375$\cancel{0}\cancel{0}$ = 1st interest.

365·234375

379·84375$\cancel{0}$

4

15·19375$\cancel{0}\cancel{0}$ = 2nd interest.

379·84375

395·03375$\cancel{0}$

4

15·8015$\cancel{0}\cancel{0}$ = 3rd interest.

395·0375

410·8390 = Amount

365·234375

45·604625 = Compound interest.

43·828125 = Simple interest.

1·7765$\cancel{0}\cancel{0}$

20

15·53$\cancel{0}\cancel{0}$

12

6·36

14·609375

3

43·828125

Difference = £1 15*s.* 6$\frac{9}{25}$*d.*

78. **Discount and Present Worth.**

Discount is a reduction made for the payment of money before it is due; the sum paid in advance being called the **present worth** or **present value.**

If A owes B £60, to be paid in 6 months, so that B has no claim on A till 6 months are passed, and A wishes to pay off the debt now, interest being reckoned at 5 per cent. per annum, B will receive that sum of money which, put out at interest for 6 months at 5 per cent., will amount to £60. The sum B receives is the present worth of the debt, and the difference between these two is the discount, **which is the interest on the present worth.**

(I.) Given the debt, rate, and time, find the **present worth.**

As 100 + (rate × time) : debt : : 100 : Ans.

What is the present worth of £1842 15*s.* payable 3 months hence at 5 per cent? (LXXXIX. 3.)

$$\frac{1}{4} \times 5 = 1\frac{1}{4}.$$

If £100 amounts to £101¼ in the time at the rate, what sum will amount to £1842¾?

$$\begin{array}{lcccccl}
 & £ & & £ & & £ & \\
\text{As} & 101\frac{1}{4} & : & 1842\frac{3}{4} & :: & \cancel{100} & : \text{Ans.} \\
 & 4 & & 4 & & 20 & \\
\hline
 & \cancel{405} & & \cancel{7371} & & & \\
 & \cancel{81} & & 91 & & & \\
 & & & 20 & & & \\
\hline
 & & & £1820 = \text{Ans.} & & &
\end{array}$$

(II.) Given the debt, rate, and time, find the **discount.**

As 100 + (rate × time) : debt : : (rate × time) : Ans.

Find the difference between the interest and discount on £7747 5*s.* for six months, reckoning 5 per cent. simple interest. (LXXXII. 3.)

$$\begin{array}{l}
\quad\quad £ \\
\tfrac{1}{20})7747{\cdot}25 \\
\hline
2)387{\cdot}3625 = \text{interest for one year.} \\
\hline
\quad 193{\cdot}68125 = \text{interest for half year.} \\
\quad\quad\quad\quad 20 \\
\hline
\quad 13{\cdot}625\cancel{00} \\
\quad\quad\quad 12 \\
\hline
\quad 7{\cdot}500 = £193\ 13s.\ 7\tfrac{1}{2}d.
\end{array}$$

$$5 \times \frac{1}{2} = 2\frac{1}{2}.$$

$$\begin{array}{lcccccl}
 & £ & & £ & & £ & \\
\text{As} & 102\frac{1}{2} & : & 7747\frac{1}{4} & :: & 2\frac{1}{2} & : \text{discount.} \\
 & 2 & & & & 2 & \\
\hline
 & \cancel{205} & & & & \cancel{5} & \\
 & 41 & & & & &
\end{array}$$

$$\frac{30989}{4} \times \frac{1}{41} = \frac{30989}{164} = £188\ 19s.\ 1\tfrac{31}{41}d.$$

$$\begin{array}{rrrl}
 & 191 & 13 & 7\frac{1}{2} \\
 & 188 & 19 & 1\frac{31}{41} \\
\hline
\text{Difference} = & 2 & 14 & 5\frac{81}{82} = \text{Ans.}
\end{array}$$

(III.) Given the discount, time, and rate, find the debt.

As the interest on £100 for the given time at the given rate : discount : : amount of £100 : debt.

If the discount on a bill due five months hence, at $3\frac{3}{4}$ per cent., is £774 12*s.* 6*d.*, what is the amount of the bill? **(XCIV. 10.)**

$$3\frac{3}{4} \times \frac{5}{12} = 1\frac{9}{16}.$$

$$\text{As } \overset{\pounds}{1\frac{9}{16}} : \overset{\pounds}{774\frac{5}{8}} :: \overset{\pounds}{101\frac{9}{16}} : \text{Ans.}$$

$$\begin{array}{ccc} 16 & 65 & 16 \\ \hline \cancel{25} & 50350\frac{5}{8} & \cancel{1625} \\ & & 65 \end{array}$$

Ans. £50350 12*s.* 6*d.*

(IV.) Given the debt, discount, and time, find the **rate**.

Present worth = debt − discount.

As the interest on the present worth, at 1 per cent., for the given time : discount : : £1 : rate.

From a bill of £3 11*s.* 8*d.*, due eighteen months hence, a tradesman deducts 5*s.*; what is the rate per cent. at which the true discount is calculated? **(CVIII. 9.)**

Present worth = £3 11*s.* 8*d.* − 5*s.* = £3 6*s.* 8*d.* = $3\frac{1}{3}$.

$$\text{Interest at 1 per cent.} = \frac{\cancel{10}}{\cancel{3}} \times \frac{\cancel{3}}{2} \times \frac{1}{\underset{10}{\cancel{100}}} = \pounds\frac{1}{20} = 1s.$$

As 1*s.* : 5*s.* : : £1 : Ans.

5 per cent.

(V.) Given the debt, discount, and rate, find the **time**.

Present worth = debt − discount.

As the interest on the present worth for one year at the given rate : discount : : 1 year : number of years.

79. Stocks.

The national debt of the country, or the "Funds," represents the money borrowed from individuals, for which interest is paid out of the annual revenue.

The name **stock** is also given to this debt, or to the capital raised by any foreign country or trading company.

Owing to various causes, the price or value of this stock varies; the interest or **dividend** remains always the same, and is paid half-yearly to the holder of stock.

By the "3 per cents. at 95⅛" is meant, that £100 stock can be purchased for £95⅛ cash, and the buyer will receive £3 interest per annum.

Stock is said to be at **par**, at a **premium**, or at a **discount**, according as the price of £100 stock is equal to, greater, or less than £100.

The purchase or sale of stock is made through a broker, who charges for commission 2*s.* 6*d.* for every £100 bought or sold (⅛ per cent.). When no mention is made of **brokerage** in a question, it is not to be taken into account. When brokerage is calculated, in buying stock, you must add £⅛ to the price of £100; in selling stock, you must deduct £⅛ from the price of £100.

The capital of a railway or trading company is obtained by issuing **shares** at a certain price, and the shareholders receive dividends half-yearly out of the profits of the company. The value of the shares varies according to the prosperity of the company.

The following questions should be carefully noticed, and in all cases **cash**, **income**, and **stock** should be distinguished.

When it is said that a man bought, sold, or transferred £5000, the £5000 is **stock**.

If he invested £5000 in the 3 per cents., &c., the £5000 is **cash**.

80. When the 3 per cents. are at 95⅛,

(I.) What is the price of £1000 stock?

As £100 stock : £1000 stock : : 95⅛ cash : Ans.

(II.) How much stock can be bought for £1000?

As £95⅛ cash : £1000 cash : : £100 stock : Ans.

(III.) What income is derived from holding £1000 stock?

As £100 stock : £1000 stock : : £3 income : Ans.

(IV.) What income is derived from investing £1000?

It is not necessary to find the amount of stock held.

£3 is derived from investing £95⅛, what is derived from investing £1000?

As £95⅛ cash : £1000 cash : : £3 income : Ans.

(V.) What sum must be invested to produce an income of £50 a year?

If I invest £95⅛ to produce £3 income, what am I to invest to produce £50 income?

As £3 income : £50 income : : £95⅛ cash : Ans.

(VI.) What stock must be held to produce an income of £50 a year?

As £3 income : £50 income : : £100 stock : Ans.

(VII.) What is the rate of interest when the 3 per cents. are at 95⅛?

As £95⅛ cash : £100 cash : : £3 income : Ans.

(VIII.) A person invests £9075 in the 3 per cents. at 90¾, and when they have risen to 91 he sells out, and invests in the 3½ per cents. at 97½; find the alteration in his income. **(XCII. 9.)**

$$\begin{array}{lcccccl}
 & \pounds & & \pounds & & \pounds & \\
\text{As} & 90\tfrac{3}{4} & : & \cancel{9}\cancel{0}\cancel{7}\cancel{5} & :: & 3 & : \text{ first income.} \\
 & \cancel{9}\cancel{0}\cdot\cancel{7}\cancel{5} & & 100 & & & \\
 & & & 3 & & & \\
\cline{4-4}
 & & & 300 & & &
\end{array}$$

$$\begin{array}{lcccccl}
 & \pounds & & \pounds & & \pounds & \\
\text{As} & \cancel{9}\cancel{0}\tfrac{3}{4} & : & \cancel{9}\cancel{0}\cancel{7}\cancel{5} & :: & 100 & : \text{ stock held in 3 per cents.} \\
 & & & 100 & & & \\
 & & & 100 & & & \\
\cline{4-4}
 & & & 10000 & & &
\end{array}$$

$$\begin{array}{lcccccl}
 & \pounds & & \pounds & & \pounds & \\
\text{As} & \cancel{1}\cancel{0}\cancel{0} & : & 100\cancel{0}\cancel{0} & :: & 91 & : \text{ cash on selling out.} \\
 & & & 91 & & & \\
\cline{4-4}
 & & & 9100 & & &
\end{array}$$

$$\begin{array}{lcccccl}
 & \pounds & & \pounds & & \pounds & \\
\text{As} & 97\tfrac{1}{2} & : & \cancel{9}\cancel{1}\cancel{0}\cancel{0} & :: & 3\tfrac{1}{2} & : \text{ second income.} \\
 & 2 & & 140 & & 2 & \\
\cline{2-2} \cline{6-6}
 & \cancel{1}\cancel{9}\cancel{5} & & 7 & & 7 & \\
\cline{4-4}
 & 3 & & 3)980 & & & \\
\cline{4-4}
 & & & 326\quad 13\quad 4 & & & \\
 & & & 300\quad\ \ 0\quad 0 & & & \\
\cline{4-4}
 & & & 26\quad 13\quad 4 = \text{Ans.} & & &
\end{array}$$

(IX.) Which is the better investment, a stock paying $3\frac{1}{2}$ per cent. at 88, or one paying 4·4 per cent. at $96\frac{2}{3}$? (XCIV. 5.)

In each stock invest £100 cash.

$$\text{As } \overset{\pounds}{\underset{22}{\cancel{88}}} : \overset{\pounds}{\underset{25}{\cancel{100}}} :: \overset{\pounds}{3\tfrac{1}{2}} : \text{first income.}$$

$$25 \times \frac{7}{2} \times \frac{1}{22} = \frac{175}{44}.$$

$$\text{As } \overset{\pounds}{96\tfrac{2}{3}} : \overset{\pounds}{100} :: \overset{\pounds}{4\tfrac{2}{5}} : \text{second income.}$$

$$\overset{2}{\cancel{100}} \times \frac{\overset{11}{\cancel{22}}}{\cancel{5}} \times \frac{3}{\underset{\underset{7}{\cancel{14}}}{\cancel{280}}} = \frac{33}{7}.$$

$$\frac{175}{44} = \frac{1225}{308}$$

$$\frac{33}{7} = \frac{1452}{308}.$$

Since the latter fraction is the greater, the latter is the better investment.

81. **Profit and Loss.**

If I buy an article for £100 (cost price or prime cost), and sell it for £110 (selling price), I gain 10 per cent.; *i.e.* £10 on an outlay of £100.

If I buy an article for £100, and sell it for £90, I lose 10 per cent., or £10 on an outlay of £100.

The gain or loss is always calculated on the prime cost.

(I.) A merchant buys certain goods at £35 per ton. At what price per lb. must he sell them in order to gain 10 per cent. on his outlay? (XLII. 15.)

$$\pounds 35 \text{ per ton} = \frac{\overset{5}{\cancel{35}}}{\underset{4}{\cancel{20}} \times \underset{16}{\cancel{112}}}\pounds \text{ per lb.} = \tfrac{1}{64}\,\pounds.$$

$$\left.\begin{aligned} &\text{Cost price} &&= \pounds\tfrac{1}{64} \\ &\text{Cost price} &&= \pounds 100 \\ &\text{Selling price} &&= \pounds 110 \end{aligned}\right\}$$

$$\text{As } \overset{\pounds}{10\cancel{0}} : \overset{\pounds}{\tfrac{1}{64}} :: \overset{\pounds}{11\cancel{0}} : \text{Ans.}$$

$$\tfrac{11}{64} \times \tfrac{1}{10} = \tfrac{11}{640}\pounds = 4\tfrac{1}{8} \text{ pence.}$$

In some questions the cost price is not actually given, but may be found from the first part of the question, and we can then solve the latter part. There is a shorter method, but it is better to solve all questions on the principle that gain or loss is on the cost price.

(II.) By selling a horse for £42 10*s*. a person lost $7\frac{1}{2}$ per cent. Find the gain or loss per cent. by selling him for £48 5*s*. (LXXXIII. 8.)

$$\left.\begin{array}{l}\text{Cost price} = \pounds 100\\ \text{Selling price} = \pounds 92\frac{1}{2}\\ \text{Selling price} = \pounds 42\frac{1}{2}\end{array}\right\}$$

As $\overset{\pounds}{92\frac{1}{2}} : \overset{\pounds}{42\frac{1}{2}} :: \overset{\pounds}{100} :$ cost price of the horse.

$$\begin{array}{cc} 2 & 2 \\ \hline \cancel{185} & \cancel{85} \\ 37 & 17 \end{array} \qquad \frac{1700}{37} = \pounds 45\frac{35}{37}.$$

$$\pounds 48\frac{1}{4} - \pounds 45\frac{35}{37} = 3 + \frac{37 - 140}{148}$$

$$= 2 + \frac{185 - 140}{148}$$

$$= 2\frac{45}{148} \text{ gain.}$$

I gain $2\frac{45}{148}$ on $45\frac{35}{37}$. What do I gain per cent.?

As $45\frac{35}{37} : 100 :: 2\frac{45}{148} :$ Ans.

$$\cancel{100} \times \frac{341}{\underset{4}{\cancel{148}}} \times \frac{\cancel{37}}{17\cancel{00}} = \frac{341}{68} = 5\frac{1}{68}$$

Ans. $5\frac{1}{68}$ per cent. gain.

82. **Proportional Parts.**

To divide a quantity in the proportion of any given numbers.

(i.) Add the numbers together, and take their sum as a common denominator.

(ii.) Take the numbers composing the given ratios separately as the numerators, and these fractional parts of the quantity will be the parts required.

Divide £857 5*s.* 8¼*d.* among 4 persons, A, B, C, and D, so that A may have twice as much as B, B three times as much as C, and C four times as much as D. (XCVIII. 8.)

$$\left.\begin{array}{lll} \text{Give D} & 1 & \text{share} \\ \text{C} & 4 & ,, \\ \text{B} & 12 & ,, \\ \text{A} & 24 & ,, \end{array}\right\}$$

$$1+4+12+24=41.$$

$\frac{1}{41}$ of £857 5*s.* 8¼*d.* = £20 18*s.* 2¼*d.* = D's share,
$\frac{4}{41}$ of £857 5*s.* 8¼*d.* = £83 12*s.* 9*d.* = C's share,
$\frac{12}{41}$ of £857 5*s.* 8¼*d.* = £250 18*s.* 3*d.* = B's share,
$\frac{24}{41}$ of £857 5*s.* 8¼*d.* = £501 16*s.* 6*d.* = A's share.

83. When the proportionate ratios are fractions.

Reduce the fractions to a common denominator; leave the denominator out of consideration, and divide the quantity in the proportion of the numerators.

Divide £2025 among A, B, C, D, and E, so that A's share is to B's share as 1 : 2; C's share to B's share as 5 : 4; D's share to C's share as 6 : 5; and E's share to D's share as 4 : 3. (LXXIII. 29.)

$$\left.\begin{array}{l} \text{Give B 1 share} = \frac{4}{4}; \\ \text{Then A has } \frac{1}{2} = \frac{2}{4}, \\ \qquad \text{C has } \frac{5}{4}, \\ \qquad \text{D has } \frac{6}{\cancel{5}} \text{ of } \frac{\cancel{5}}{4} = \frac{6}{4}, \\ \qquad \text{E has } \frac{4}{3} \text{ of } \frac{3}{2} = 2 = \frac{8}{4}. \end{array}\right\}$$

$$4+2+5+6+8=25.$$

$$\frac{4}{\cancel{25}} \text{ of } £\overset{81}{\cancel{2025}} = £324 = \text{B's share,}$$

$$\frac{2}{25} \text{ of } £2025 = £162 = \text{A's share,}$$

C = £405, D = £486, E = £648.

84. To find the average or mean of several quantities.

Divide their sum by the number of the quantities.

Find the average of $12\frac{19}{25}$, 21, $7\frac{3}{4}$, ·034, $3\frac{1}{8}$, 0, $24\frac{1}{2}$, and $12\frac{7}{20}$. Express the fractional part decimally. (LXXXVII. 3.)

$$\begin{array}{r@{\cdot}l}
12 & 76 \\
21 & \\
7 & 75 \\
 & 034 \\
3 & 125 \\
0 & \\
24 & 5 \\
12 & 35 \\ \hline
8)81 & 519 \\ \hline
10 & 189875
\end{array}$$

85. Equation of Payments.

When several sums of money are due at different times, we can find the just or equated time when the whole debt may be discharged in one payment.

Multiply each debt by the time after which it becomes due, and then divide the sum of the products by the sum of the debts; the quotient will be the equated time.

The sum of £434 is due as follows: $\frac{1}{3}$ of it in 4 months, $\frac{1}{5}$ of it in 5 months, and the remainder in 7 months. Find the equated time for one payment of £434. (CVII. 18.)

$$\text{Required time} = \frac{(\frac{434}{3} \times 4) + (\frac{434}{5} \times 5) + (\frac{7}{15} \text{ of } 434 \times 7)}{434} \text{ months}$$

$$= \frac{4}{3} + 1 + \frac{49}{15} = 1\frac{1}{3} + 1 + 3\frac{4}{15} = 5\frac{3}{5} \text{ months.}$$

86. Chain Rule.

The Chain Rule enables us to combine several ratios, so that the ratio of the first and last term may be found.

If a_1 things of the first kind $= b_1$ things of a second kind,
a_2 „ second „ $= b_2$ „ third „
a_3 „ third „ $= b_3$ „ fourth „
Then $a_1 \times a_2 \times a_3 \times \ldots$ of the first kind $= b_1 \times b_2 \times b_3 \times \ldots$ of the last kind.

If 13 solid inches of copper balance 17 of iron, and 15 of iron balance 16 of tin, and 19 of tin balance 12 of zinc, how many solid inches of zinc balance 1235 inches of copper? (CXI. 1.)

$$
\begin{aligned}
13 \text{ copper} &= 17 \text{ iron},\\
15 \text{ iron} &= 16 \text{ tin},\\
19 \text{ tin} &= 12 \text{ zinc}.
\end{aligned}
$$

$$\therefore\quad 13 \times 15 \times 19 \text{ copper} = 17 \times 16 \times 12 \text{ zinc}.$$

$$\therefore\quad 1 \text{ copper} = \frac{17 \times 16 \times 12}{13 \times 15 \times 19} \text{ zinc}.$$

$$\therefore\quad 1235 \text{ copper} = \overset{247}{\cancel{1235}} \times \frac{17 \times 16 \times \overset{4}{\cancel{12}}}{\cancel{13} \times \underset{5}{\cancel{15}} \times \cancel{19}} = 1088 \text{ zinc}.$$

87. Exchange.

Exchange is a rule by which we can find how much money of one country is equal in value to a given sum of another country.

The **par of exchange** is the real comparative value of the money of two countries.

The **course of exchange** is the undetermined or variable sum of one currency which is equivalent to a fixed sum in another.

Bills of exchange are written orders for the payment of money at certain times.

The **arbitration of exchange** is the method of fixing upon the rate of exchange between the first and last of a given number of countries when the course of exchange between the first and second, the second and third, &c., of these countries is known.

A person in London wishes to remit a debt of 1016 pistoles to Madrid when the exchanges are 1 Spanish pistole = 15*s.*, £1 = 25·4 francs, 19 francs = 1 Spanish pistole. Is it more advantageous to remit directly to Madrid, or circuitously through Paris? (CVII. 16.)

$$1 \text{ pistole} = 15s.,$$

$$\therefore\quad 1016 \text{ pistoles remitted direct} = \overset{254}{\cancel{1016}} \times £\frac{\overset{3}{\cancel{15}}}{\underset{4}{\cancel{20}}} = £762,$$

$$
\begin{aligned}
20 \text{ shill.} &= 25{\cdot}4 \text{ francs},\\
19 \text{ fr.} &= 1 \text{ pistole};
\end{aligned}
$$

$$\therefore\quad 20 \times 19 \text{ shill.} = 25{\cdot}4 \text{ pistoles};$$

$$\therefore\quad 1 \text{ pistole} = \frac{20 \times 19}{25{\cdot}4}\text{shill.} = £\frac{190}{254};$$

$$\therefore\quad 1016 \text{ pistoles remitted by Paris} = \overset{4}{\cancel{1016}} \times \frac{\overset{£}{190}}{\cancel{254}} = \overset{£}{760};$$

$\therefore$ the latter is the most advantageous.

88. **Time, work, &c.**

If a man can do a piece of work in 5 days, he will do $\frac{1}{5}$ of the work in 1 day.

If a tap can fill a cistern in 5 hours, it will fill $\frac{1}{5}$ of the cistern in 1 hour.

Given the time A and B can do a piece of work separately, in what time can they do it working together?

Find the fractions of work done by each in a unit of time, add them together, and the resulting fraction inverted will be the number of units of time required.

(I.) A can dig a certain length of ditch in 3 days, B can do the same in 4 days, and C in 5 days. How long will it take them all together to dig the same length of ditch? and what proportion of the work will be done by each? **(LXXVIII. 27.)**

A can do $\frac{1}{3}$ in 1 day
B " $\frac{1}{4}$ "
C " $\frac{1}{5}$ "

$\therefore$ A, B, and C do $\frac{1}{3}+\frac{1}{4}+\frac{1}{5}$ in 1 day,

$\frac{20+15+12}{60}$ in 1 day,

$\frac{47}{60}$ in 1 day.

A, B, and C take $\frac{60}{47}$ days $= 1\frac{13}{47}$ days.
A will do $\frac{20}{47}$, B $\frac{15}{47}$, and C $\frac{12}{47}$.

(II.) Three taps, A, B, and C, can fill a cistern, A by itself in 24 minutes, B in 10 minutes, and C in 27 minutes. They are all three turned on at once, and after running $4\frac{1}{2}$ minutes B and C are turned off; how long will A then take by itself to complete the filling of the cistern? **(XCIV. 12.)**

$$\left.\begin{array}{l} \text{A fills } \frac{1}{24} \text{ in 1 minute} \\ \text{B} \quad " \quad \frac{1}{10} \quad\quad " \\ \text{C} \quad " \quad \frac{1}{27} \quad\quad " \end{array}\right\}$$

A, B, and C fill $\frac{1}{24}+\frac{1}{10}+\frac{1}{27}$ in 1 minute

$= \frac{45+108+40}{1080}$ "

$= \frac{193}{1080}$ in 1 minute

$= \frac{193}{\underset{120}{\cancel{1080}}} \times \frac{\cancel{9}}{2}$ in $4\frac{1}{2}$ minutes

$= \frac{193}{240}$;

$\therefore \quad 1 - \frac{193}{240} = \frac{47}{240}$ of cistern remains to be filled by A.

A fills $\frac{1}{24}$ in 1 minute, and $\therefore \frac{47}{240} \times 24$ minutes = Ans.

$$= \frac{47}{10} = 4\tfrac{7}{10} \text{ minutes.}$$

89. **Square Root.**

The **square root** of a number is that number whose square is equal to the given number.

A number which has an exact square root is called a **perfect square.**

Every even perfect square is divisible by 4.

Every odd perfect square, diminished by 1, is divisible by 4.

No perfect square can end with 2, 3, 7, or 8.

If the last figure of a perfect square is 5, the last but one must be 2.

90. To extract the square root of a number.

(i.) Divide the number into **periods** of two figures each, placing a dot over the unit figure and over every alternate figure. The number of figures in the root will be equal to the number of periods.

(ii.) Place in the quotient the greatest number whose square is contained in the first period on the left, and subtract its square from the first period, and to the remainder bring down the next period to form the first dividend.

(iii.) Double the quotient and place the number to the left of the dividend; this is the **trial divisor.**

(iv.) Cut off the unit figure of the dividend and divide by the trial divisor, placing the figure in the quotient and also to the right of the trial divisor, making it the complete divisor.

(v.) Multiply the complete divisor by the figure last found in the quotient, and subtract the result from the dividend.

(vi.) Continue the process until all the periods have been brought down, and the quotient will be the required square root.

N.B.—If at any stage of the process the dividend, with the unit figure cut off, is less than the trial divisor, place a cypher in the quotient, and also annex one to the trial divisor, and then bring down the next period.

Extract the square root of 3914879761. **(LXXXVIII. 2.)**

```
         3914879761(62569
         36
         ——
    122...314
          244
          ———
   1245...7087
          6225
          ————
  12506...86297
          75036
          —————
 125129...1126161
          1126161
          ———————
          . . . .          Ans. 62569.
```

91. To extract the square root of a decimal, begin to point from the units' place, and mark off periods to the right and left, annexing a cypher, if necessary, to make the number of decimal places even. Place the point in the question when the last period of the whole number has been brought down.

Find the square root of ·0043046721. **(LXXVIII. 30.)**

```
      ·0043046721(·06561
         36
         ——
    125...704
          625
          ———
   1306...7967
          7836
          ————
  13121...13121
          13121
          —————
          . . .            Ans. ·06561.
```

92. When one more than half the number of figures in the root have been obtained, the rest of the root may be found by converting the dividend and the trial divisor into a simple division sum, and annex the quotient to the figures already found in the root.

Find the square root of ·07 to 5 places of decimals.

(XCII. 2.)

$$
\begin{array}{l}
\quad\ \cdot 0\dot{7}(\cdot 264 \\
\quad\ \ \underline{4} \\
46\ldots 300 \\
\qquad \underline{276} \\
524\ldots 2400 \\
\qquad\ \ \underline{2096} \\
\quad 528)\cdot 30400(57 \\
\qquad\quad \underline{2640} \\
\qquad\qquad \cdot 4000 \\
\qquad\qquad \underline{3696} \\
\qquad\qquad \cdot 304
\end{array}
$$

Ans. ·26457.

93. To extract the square root of a vulgar fraction.

Find the square root of the numerator and denominator separately.

If a mixed number, reduce it to an improper fraction, and find the square root of the numerator and denominator.

If the denominator is not a perfect square, multiply the numerator and denominator by the number which will make the denominator a perfect square, and find the square root of each separately.

Find the square root of $83\frac{193}{529}$.

(XXXIII. 29.)

$$\text{Fraction} = \frac{44100}{529}.$$

$$\text{Square root} = \frac{210}{23}.$$

94. **Square Measure.**

To find the area of a rectangle.

Reduce the length and breadth to the same denomination, multiply them together, and the result will be the number of square units of the same denomination in the area.

We will abbreviate this by saying length × breadth = area. In the same way we may say, area of the four walls of a room = 2 height (length + breadth).

Length of paper of a given width required to paper the four walls $= \dfrac{\text{area of four walls}}{\text{width of the paper}}$.

A room is 34 feet 8 inches long, 13 feet 6 inches wide, and 10 feet 9 inches high. Find the cost of papering it with paper 1 foot 10 inches wide, at *6d.* per yard, and of carpeting it with carpet $\frac{3}{4}$ yard wide, at 3*s.* $4\frac{1}{2}$*d.* per yard.

Area of 4 walls $= 2\text{H}\,(\text{L}+\text{B})$ **(LXXXVII. 11.)**

$$= 2 \times 10\tfrac{3}{4}\,[34\tfrac{2}{3} + 13\tfrac{1}{2}] \text{ square feet}$$

$$= 2 \times \tfrac{43}{4} \times 48\tfrac{1}{6}$$

Length of paper $= \cancel{2} \times \dfrac{43}{\underset{2}{\cancel{4}}} \times \dfrac{289}{\cancel{6}} \times \dfrac{\cancel{6}}{11}$ feet, ∵ 1 ft. 10 in. $= 1\frac{5}{6}$ ft.

$$= \frac{43 \times 289}{22} \times \tfrac{1}{3} \text{ yards}$$

$$\text{Cost} = \frac{43 \times 289}{22} \times \tfrac{1}{3} \times \tfrac{1}{2} \text{ shillings}$$

$$= \frac{12427}{132} = £4\ 14s.\ 1\tfrac{8}{11}d.$$

Area of floor $= 34\frac{2}{3} \times 13\frac{1}{2}$ square feet

$$= \frac{\overset{52}{\cancel{104}}}{\cancel{3}} \times \frac{\cancel{27}}{\cancel{2}} \times \frac{1}{\cancel{9}} \text{ square yards}$$

Length of carpet $= 52 \times \frac{4}{3}$ yards

$$\text{Cost} = 52 \times \tfrac{4}{3} \times 40\tfrac{1}{2} \text{ pence}$$

$$= 52 \times \frac{\overset{2}{\cancel{4}}}{\cancel{3}} \times \frac{\overset{27}{\cancel{81}}}{\cancel{2}}$$

$$= 2808d.$$

$$= £11\ 14s.$$

95. Cube Root.

The **cube root** of a number is that number whose cube is equal to the given number.

A number which has an exact cube root is called a **perfect cube.**

To extract the cube root of a number.

(i.) Divide the number into periods of three figures each, placing a dot over the unit figure and over every third figure.

(ii.) Place in the quotient the greatest number whose cube is contained in the first period on the left, and subtract its cube from the first period, bringing down to the remainder the next period to form the first dividend.

(iii.) Make two columns on a line, with the dividend to the left of it; in the left-hand column place 3 times the quotient; in the right-hand column 3 times the square of the quotient, with two cyphers annexed. This is the **trial divisor.**

(iv.) Divide the dividend by the trial divisor, and annex the result to the quotient, and also to the left-hand column.

(v.) Multiply the left-hand column by the last found figure in the quotient, and add the product to the right-hand column.

(vi.) Multiply the right-hand column by the last found figure in the quotient, and subtract the product from the dividend.

(vii.) Continue the process until all the periods have been brought down, and the quotient will be the required cube root.

Find the cube root of 9555119848. (LXXII. 28.)

		$\dot{9}55\dot{5}11\dot{9}84\dot{8}$(2122
		8
61...	1200...	1555
	61	
	1261	1261
632...	132300...	. 294119
	1264	
	133564	267128
6362	13483200	. 26991848
	12724	
	13495924	26991848
		. . . . .

Cube root = 2122.

96. To extract the cube root of a decimal.

Begin to point at the units' place, marking off periods right and left, and make the number of decimal places a multiple of three by adding one or two cyphers, if necessary.

Find the cube root of 40·353607. **(LXXVIII. 30.)**

```
                  4̇0·353̇607̇(3·43
                  27
94...2700...   | 13353
        376    |
       3076    | 12304
1023   346800  | 1049607
         3069  |
       349869  | 1049607
                 ....
```

Ans. 3·43.

97. To extract the cube root of a vulgar fraction.

If a mixed number, reduce it to an improper fraction, and find the cube root of the numerator and denominator separately.

(I.) Extract the cube root of $2\frac{1371}{2744}$. **(XCIX. 2.)**

$$\text{Fraction} = \frac{6859}{2744}.$$

$$\text{Cube root} = \frac{19}{14} = 1\frac{5}{14}.$$

(II.) A cube contains $18\cdot\dot{9}6\dot{2}$ cubic yards; find how many linear feet there are in an edge. **(XLVI. 26.)**

$$18\cdot\dot{9}6\dot{2} = 18\frac{962}{999} = 18\frac{26}{27} = \frac{512}{27}.$$

$$\text{Cube root} = \frac{8}{3} \text{ yards}$$

$$= 8 \text{ feet.}$$

98. **Cubic Measure.**

To find the cubical content or volume of a rectangular solid.

Reduce the length, breadth, and depth to the same denomination. Multiply the results together, and the product will be the number of cubic units of the same denomination.

99. **Duodecimals.**

$12''''$ (fourths) $= 1'''$ (third)
$12'''$ (thirds) $= 1''$ (second or parts)
$12''$ (seconds or parts) $= 1'$ (prime or inch)
$12'$ (primes) $= 1$ foot.

Any number of *feet* × any number of *feet* = a number of sq. ft.
„ *feet* × „ primes (′) = a num. of sq. primes.
„ *feet* × „ seconds (″) = a number of square seconds or sq. in.
„ *primes* (′) × „ primes (′) = a number of sq. in.

In all cases the product will be the denomination shown by the sum of the indices.

100. To multiply by duodecimals.

(i.) Write the terms of the multiplier under the corresponding terms of the multiplicand, feet under feet, primes under primes, &c.

(ii.) Multiply each term of the multiplicand, beginning with the lowest denomination, by the term of highest denomination in the multiplier, and set down the product, carrying 1 for every 12.

(iii.) Multiply by the next highest denomination of the multiplier, and set down the products one place removed to the right.

(iv.) Continue the process until each term of the multiplier has been dealt with, and add the products together for the result.

(1) Multiply by duodecimals 13 feet 5 inches 7 parts by 9 feet 3 inches 11 parts. What does the product become when expressed in square feet, square inches, and a fraction of a square inch?

(**LXXXV.** 8.)

ft.	in.	pts.		
13	5	7		
9	3	11		
121	2	3		
3	4	4	9	
1	0	4	1	5
125	6	11	10	5

$\frac{6}{12}+\frac{11}{144}=\frac{83}{144}$ square feet = 83 square inches.

$\frac{10}{12}+\frac{5}{144}=\frac{125}{144}$ square inches.

Ans. 125 sq. feet $83\frac{125}{144}$ sq. inches.

(2) Multiply by duodecimals 8 feet 2 inches 4 parts by 4 feet 6 inches 9 parts, and the product by 3 feet 7 inches.

What does the product become when expressed in cubic feet, cubic inches, and a fraction of a cubic inch? **(XLV. 23.)**

ft.	in.	pts.		
8	2	4		
4	6	9		
32	9	4		
4	1	2	0	
	6	1	9	0
37	4	7	9	0
3	7			
112	1	11	3	
21	9	8	6	3
133	11	7	9	3

$\frac{11}{12}+\frac{7}{144}+\frac{9}{1728}=\frac{1584+84+9}{1728}=\frac{1677}{1728}$ c. ft. = 1677 c. in.,

$\frac{3}{12}=\frac{1}{4}$ cubic inches.

Ans. 133 cubic feet 1677¼ cubic inches.

TABLE OF SQUARES, CUBES, SQUARE AND CUBE ROOTS.

No.	Square.	Cube.	Square Root.	Cube Root.
1	1	1	1	1
2	4	8	1.414213	1.259921
3	9	27	1.732050	1.442249
4	16	64	2	1.587401
5	25	125	2.236068	1.709976
6	36	216	2.449489	1.817121
7	49	343	2.645751	1.912931
8	64	512	2.828427	2
9	81	729	3	2.080083
10	100	1000	3.162277	2.154434
11	121	1331	3.316624	2.223980
12	144	1728	3.464101	2.289428
13	169	2197	3.605551	2.351335
14	196	2744	3.741657	2.410142
15	225	3375	3.872983	2.466212
16	256	4096	4	2.519842
17	289	4913	4.123105	2.571281
18	324	5832	4.242640	2.620741
19	361	6859	4.358898	2.668402
20	400	8000	4.472136	2.714417

FORMULÆ IN MENSURATION.

$\sqrt{2}=1{\cdot}414213$ $\sqrt{3}=1{\cdot}732050$ $\pi=3{\cdot}1416$, or $\frac{22}{7}$.

Circumference of a circle $=2\pi r$; $r=$ radius.

Length of arc of a circle subtending an $\angle\cdot\ a^\circ$ at the centre $=\frac{\pi r\cdot a^\circ}{180^\circ}$; by Eucl. i. 32, $na^\circ+360^\circ=n\cdot 180^\circ$; $a^\circ=$ angle of a regular polygon of n sides.

Diagonal of a square $=\sqrt{2}\times a$; $a=$ side of square.

Diagonal of a cube $=\sqrt{3}\times a$; $a=$ side of cube.

Area of rectangle $=ab$; a and b being adjacent sides.

Area of parallelogram $=$ base $\times$ height, or $ab\sin\theta$; a and b being adjacent sides, including an angle θ.

Area of four walls of a room $=2$ height $\times$ (length $+$ breadth).

Area of a trapezoid $=\frac{1}{2}p\,(a+b)$; p being the perpendicular distance between the parallel sides a, b.

Area of a triangle $=\frac{1}{2}$ height $\times$ base, or $\frac{1}{2}\,ab\sin C$, or $\sqrt{s\,(s-a)\,(s-b)\,(s-c)}$; $s=\frac{a+b+c}{2}$ ($\frac{1}{2}$ the perimeter).

Area of an equilateral triangle $=\frac{\sqrt{3}\cdot a^2}{4}$; $a=$ side of triangle.

Area of quadrilateral inscribed in a circle $=\sqrt{(s-a)\,(s-b)\,(s-c)\,(s-d)}$; $s=\frac{a+b+c+d}{2}$ ($\frac{1}{2}$ the perimeter).

Area of a regular polygon $=\frac{na^2}{4}\cot\frac{180^\circ}{n}$; $n=$ number of sides each equal to a.

Radius of circle inscribed in a triangle $=\frac{S}{s}$; $S=$ area of triangle, $s=\frac{1}{2}$ perimeter.

Radius of circle described about a triangle $=\frac{abc}{4S}$.

Area of circle $=\pi r^2$; $r=$ radius.

Area of sector of circle $=\pi r^2\times\frac{a^\circ}{360^\circ}$; or $\frac{1}{2}$ arc $\times$ radius; $a^\circ=$ angle of sector.

Area of segment of circle less than a semi-circle $=$ area of sector $-$ area of triangle.

Area of circular ring $=\pi(r^2-r_1{}^2)=\pi(r+r_1)\ (r-r_1)$; r and r_1 are the radii of the outer and inner circles.

Curved surface of cylinder $=2\pi rh$; $r=$ radius of base, h $=$ height.

Whole surface of cylinder $=2\pi rh+2\pi r^2=2\pi r\ (r+h)$.

Curved surface of cone $=\pi rl$; $l=$ slant height $=\sqrt{r^2+h^2}$.

Curved surface of frustum of cone $=\pi l\ (r+r_1)$; $l=$ slant height r, r_1 the radii of the ends.

Surface of sphere $=4\pi r^2$.

Surface of segment of sphere $=2\pi rh$; $h=$ height of segment.

Areas of similar figures are as the squares of corresponding or homologous lengths. (Euc. vi. 19.)

Volume of a parallelopiped $=$ length × breadth × height.

Volume of a cube $=a^3$; $a=$ edge of cube.

Volume of cylinder $=\pi r^2h$; $r=$ radius of base, $h=$ height.

Volume of pyramid or cone $=\frac{h}{3}\times$ area of base; $h=$ height.

Volume of frustum of pyramid or cone $=\frac{h}{3}\ (\mathrm{A}+\mathrm{B}+\sqrt{\mathrm{AB}})$ $h=$ height, A B, the areas of the ends of the frustum.

Volume of a solid ring $=\pi r^2l$; $l=$ length of ring, $r=$ radius of circular section.

Volume of sphere $=\frac{4}{3}\ \pi r^3$; $r=$ radius.

Volume of spherical shell $=\frac{4}{3}\pi\ (r^3-r_1{}^3)$; r, r_1 being the outer and inner radii.

Volume of segment of sphere $=\frac{\pi h}{6}(h^2+3r^2)$; $r=$ radius of base, $h=$ height of segment; or, $\pi h^2\left(r-\frac{h}{3}\right)$; $r=$ radius of sphere, $h=$ height of segment.

Volume of zone of sphere $=\frac{\pi h}{6}(h^2+3\,(r^2+r_1{}^2))$; r and r_1 the radii of the ends, $h=$ height of zone.

Volumes of similar solids are as the cubes of corresponding lengths.

LOGARITHMS.

The Logarithm of a number to a given base is the index of the power to which the base must be raised to give the number.

$\text{Log}_a m = x$, then $a^x = m$.

$\text{Log}_a a = 1$.

$\text{Log}_a 1 = 0$.

$\text{Log}_a 0 = -\infty \quad (a > 1)$.

$\text{Log}_a mn = \text{Log}_a m + \text{Log}_a n$.

$\text{Log}_a \frac{m}{n} = \text{Log}_a m - \text{Log}_a n$.

$\text{Log}_a m^p = p \times \text{Log}_a m$.

$\text{Log}_a m^{\frac{1}{p}} = \frac{1}{p} \times \text{Log}_a m$.

$\text{Log}_a b \times \text{Log}_b a = 1$.

$\text{Log}_a m = \text{Log}_b m \times \frac{1}{\text{Log}_b a}$.

$\frac{1}{\text{Log}_b a}$ is called the **Modulus,** or multiplier for transforming the Log. of a number to base b, to the Log. of the same number to base a.

The base of the common system is 10.

$\text{Log}_{10}(\text{N} \times 10^n) = \text{Log}_{10}\text{N} + n$.

$\text{Log}_{10}(\text{N} \div 10^n) = \text{Log}_{10}\text{N} - n$.

The **Mantissa** is the decimal part of a Logarithm.

The **Characteristic** is the integral part of a Logarithm.

The Logs. of all numbers consisting of the same digits in the same order have the same mantissæ; thus, the mantissa of the Logs. of 1234, 123·4, ·1234, 12340, ·001234, is ·0913152.

The characteristic of the Log. of a number is *one less* than the number of digits in the whole number.

When the number has no integral figures, the characteristic of the Log. is *negative*, and is *one more* than the number of cyphers which precede the first significant digit, that is, the number of cyphers immediately after the decimal point;

thus, the characteristics of the Logs. of 1234, 123·4, ·1234, 12340, ·001234, are respectively 3, 2, $\bar{1}$, 4, $\bar{3}$.

When only a certain number of decimal places is required, strike out the rest of the figures, and increase the last retained figure by 1 if the first figure struck off be 5, or greater than 5.

Simple Interest.

P = Principal, M = Amount, n = number of years, r = rate per £ per year, I = Interest, D = Discount on P.

$I = Pnr.$

$M = P + Pnr.$

$D = \frac{Pnr}{1 + nr}.$

$D = \frac{PI}{P + I}$ A formula connecting the discount and interest of a sum of money for the same time at the same rate.

Present value of $P = \frac{P}{1 + nr}.$

Compound Interest.

R = amount of £1 in 1 year $= 1 + r$; thus, at 3 per cent., $R = 1{\cdot}03$; at 2½ per cent., $R = 1{\cdot}025$, &c.

$M = PR^n.$

$I = PR^n - P.$

Present value of $P = \frac{P}{R^n}.$

Discount of P $= \frac{P(R^n - 1)}{R^n}.$

Amount of P in n years, interest payable q times a year,

$$= P\left(1 + \frac{r}{q}\right)^{nq}.$$

EXAMINATION PAPERS.

Preliminary Examination for Admission to the Royal Military College, Sandhurst.

(N.B.—You are particularly recommended to answer the questions in the order in which they are set; not omitting any one unless you are unable to do it. Do not lose time by copying out the questions, but refer to each question by its number.)

(Two and a half hours).

I.

1. Add together $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, and $\frac{7}{8}$.

*2. Subtract $2\frac{1}{4}$ from $20\frac{1}{8}$.

3. Multiply $\frac{4}{11}$ by $1\frac{4}{7}$.

4. Divide $2\frac{3}{4}$ by $1\frac{1}{16}$.

*5. Add together 16·41215, 9·376, ·00403, and 270·3.

6. Subtract 17·2398 from 27·06.

7. Multiply 46·2375 by ·0074.

8. Divide 92·3784 by ·623 to three places of decimals.

9. Find the value of 1·25 of £1 13*s.* 4*d.*

10. Reduce 4 tons 3 cwt. 1 qr. 9 lbs. to ounces.

11. Find the income tax on £356 10*s.* at 5*d.* in the £.

*12. Find the simple interest on £576 for 6 years at $4\frac{1}{2}$ per cent. per annum.

13. Add together $1\frac{7}{12}$, $3\frac{7}{24}$, and $4\frac{1}{3}$.

*14. Subtract $5\frac{3}{20}$ from $10\frac{1}{10}$.

15. Multiply together $\frac{9}{14}$, $\frac{5}{27}$, $9\frac{4}{5}$, and $2\frac{2}{7}$.

16. Divide $2\frac{13}{14}$ by $4\frac{1}{7}$.

17. Add together 2·6 of a day and ·85 of an hour, and give the answer in minutes.

18. Subtract 4·42 of a cwt. from 3·64 of a ton.

19. Multiply 62·5 by ·579.

20. Divide ·473928 by 24·18.

21. Express ·0425 of a mile in yards.

22. In 156704 square inches how many square yards and square feet are there?

23. What is the income of a man whose income tax at 4*d.* in the pound amounts to 23 guineas?

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* Questions marked with an asterisk (*) have been previously selected to illustrate the arithmetical rules.

24. At what rate per cent. will £230 15*s.* amount to £305 14*s.* 10$\frac{1}{2}$*d.* in 13 years at simple interest?

25. Find the dividend on £274 10*s.* at 8*s.* 3*d.* in the £.

*26. If 2 horses can plough 7 acres of ground in a day, how many horses will be required to plough 161 acres in 11$\frac{1}{2}$ days?

II.

1. Add together 4$\frac{2}{5}$, $\frac{2}{3}$, 1$\frac{7}{15}$, and 3$\frac{5}{6}$.

2. Subtract $\frac{4}{7}$ from 6$\frac{5}{21}$.

3. Multiply 13$\frac{1}{2}$ by 1$\frac{5}{9}$.

4. Divide 7$\frac{3}{10}$ by 1$\frac{4}{5}$.

5. Add together ·006, 1·27, 39·567, and 140·806.

6. Subtract 159·643 from 240·321.

7. Multiply 537·6 by 40·56.

8. Divide 16·0134 by ·39.

9. Express 6·545 of 12*s.* 6*d.* in pence and the decimal fraction of a penny.

10. Reduce 2 quarters 3 bushels 2 pecks to pints.

11. If 37 articles cost £8 11*s.* 1$\frac{1}{2}$*d.*, how many can be bought for £35 3*s.*?

12. Find the simple interest on £480 for 5 years at 3$\frac{1}{2}$ per cent. per annum.

13. Add together 3$\frac{2}{7}$, 4$\frac{1}{3}$, $\frac{1}{6}$, and $\frac{16}{21}$.

14. Subtract 2$\frac{17}{39}$ from 5$\frac{2}{13}$.

15. Multiply together 5$\frac{4}{7}$ of 2$\frac{2}{13}$, $\frac{5}{8}$, and 1$\frac{2}{15}$.

16. Divide 4$\frac{9}{10}$ by 12$\frac{5}{6}$.

17. Add together 12·36 of a ton and ·03475 of a cwt.; and give the answer in pounds, ounces, and the decimal fraction of an ounce.

18. Subtract 18·52 of a shilling from 21·43 of a crown.

19. Multiply 4·0576 by ·0068.

20. Multiply together ·01, ·17, and 1·06.

21. Divide ·01461201 by 357.

22. Divide ·75973 by ·00205.

23. Reduce 13 yards 27 inches to the decimal of 5 miles.

24. If 6 yards of silk cost £1 7*s.* 9*d.*, what will 177 yards cost?

25. At what rate per cent. simple interest will £2630 amount to £3090 5*s.* in 3$\frac{1}{2}$ years?

26. If the price of 3 per cent. Consols is 96, what interest does it afford to an investor?

III.

1. Add together $\frac{4}{7}$, $1\frac{5}{6}$, $\frac{8}{21}$, and $\frac{11}{42}$.

2. Subtract $6\frac{4}{5}$ from $8\frac{3}{7}$.

3. Multiply $4\frac{1}{5}$ by $\frac{10}{63}$.

4. Divide $1\frac{7}{8}$ by $3\frac{5}{12}$.

5. Add together 70·152, ·00628, 1·905, and 3281·6013.

6. Subtract 47·6125 from 350·013.

7. Multiply 501·32 by ·0063.

8. Divide 17·465 by 98·6 to three places of decimals.

9. Find the value of 6·125 of £1 13*s.* 4*d.*

*10. In 3706529 inches how many miles, furlongs, poles, &c. are there?

11. If 69 lbs. of salt cost 7*s.* 2¼*d.*, what will be the value of 4 cwt. 1 qr. 7 lbs.?

12. Find the simple interest on £5781 for 10 years at 4½ per cent. per annum.

13. Add together $5\frac{2}{9}$, $3\frac{1}{12}$, and $1\frac{4}{27}$.

14. Subtract $7\frac{8}{11}$ from $10\frac{12}{143}$.

15. Multiply together $10\frac{1}{8}$, $\frac{6}{13}$, $\frac{26}{27}$, and $1\frac{1}{3}$.

16. Divide $6\frac{4}{9}$ by $2\frac{4}{63}$.

17. Add together 1·375 gallons and 3·5 quarts.

18. Subtract 33·75 of a minute from 1·95 of an hour.

19. Multiply ·401296 by 8·05.

20. Divide 2054·95 by ·0563.

21. Express 7*s.* 9¾*d.* as the decimal of £8.

*22. In 57625318 square inches how many acres, roods, &c. are there?

23. A person, after paying an income-tax on £515, has £484 19*s.* 2*d.* left; how much did he pay in the £?

24. A bankrupt's estate amounts to £910 3*s.* 1½*d.*, and his debts to £1875; what can he pay in the £?

25. At what rate per cent. will £425 amount to £573 15*s.* in 5 years at simple interest?

26. Find (by Practice) the value of 5 cwt. 3 qrs. 21 lbs. at £1 5*s.* 8*d.* per cwt.

27. A person completes a journey of 1056 miles in 12 days, travelling 11 hours a day; in how many days would he complete 480 miles, going 6 hours a day at the same rate?

IV.

1. Add together $\frac{3}{8}$, $2\frac{5}{32}$, $\frac{1}{3}$, and $\frac{5}{12}$.
2. Subtract $9\frac{7}{15}$ from $12\frac{3}{20}$.
3. Multiply $10\frac{11}{12}$ by $2\frac{2}{3}$.
4. Divide 9 by $6\frac{3}{13}$.
5. Add together 1·905, 3281·6013, 42·3078, and ·05869.
6. Subtract 54·39856 from 101·2891.
7. Multiply 55·286 by ·02514.
8. Divide 3·3 by 26·4.
9. Find the value of ·0725 of £1 6*s.* 8*d.*
10. In 424768 ounces Avoirdupois, how many tons, cwts., &c.?
11. If 3 cwt. 2 qrs. of iron cost £1 4*s.* 6*d.*, what is the value of a ton?
12. Find the simple interest on £4950 for 12 years at $3\frac{3}{4}$ per cent. per annum.
13. Add together $1\frac{7}{9}$, $2\frac{4}{11}$, $\frac{5}{6}$, and $3\frac{10}{33}$.
14. Subtract $13\frac{7}{12}$ from $20\frac{11}{30}$.
15. Multiply together $3\frac{1}{16}$, $\frac{5}{9}$, $1\frac{1}{3}$, and $\frac{2}{7}$.
16. Divide $8\frac{1}{8}$ by $\frac{5}{16}$.
17. Add together 2·15 oz. and ·0075 of a cwt.
18. Subtract ·25 of half a crown from ·15 of half a guinea.
19. Multiply ·65431 by 2·54.
20. Divide 255·3 by ·575.
21. Express 2*s.* 6*d.* as the decimal of £5.
22. Reduce 1 acre 2 roods 3 poles 4 yards to square inches.
23. If $5\frac{1}{4}$ cwt. of sugar cost 23 guineas, what is the value of 196 lbs.?
24. If 28 lbs. of tea at 3*s.* 6*d.* a lb. be mixed with 56 lbs. which cost £5 12*s.*, what is the cost per lb. of the mixture?
25. In what time will £1500 amount to £1719 7*s.* 6*d.* at $4\frac{1}{2}$ per cent. per annum, simple interest?
26. Find (by Practice) the value of 3 oz. 15 dwts. 12 grs. of gold at £3 15*s.* per oz.
27. If 2 horses can plough 7 acres of ground in a day, how many horses will be required to plough 161 acres in $11\frac{1}{2}$ days?

V.

1. Add together $4\frac{3}{16}$, $\frac{2}{9}$, $2\frac{5}{12}$, and $\frac{1}{2}$.
2. Subtract $11\frac{6}{11}$ from $15\frac{1}{10}$.
3. Multiply $13\frac{5}{9}$ by $3\frac{3}{61}$.
4. Divide $12\frac{5}{17}$ by $3\frac{1}{34}$.
5. Add together 3281·6013, 42·307, 8·42, and ·05869.
6. Subtract 19·28945 from 200·1076.
7. Multiply 169·35 by ·00265.
8. Divide 16·1 by 64·4.
9. Reduce ·0545 of £2 7*s.* 6*d.* to pence and the decimal of a penny.
10. Reduce 1 lb. 2 oz. 3 dwts. to grains Troy.
11. If £39 19*s.* will buy 47 tons, how much may be bought for 11*s.* $8\frac{1}{4}$*d.*?
12. Find the simple interest on £950 for 8 years at $5\frac{1}{2}$ per cent. per annum.
13. Add together $3\frac{5}{12}$, $\frac{3}{25}$, $2\frac{1}{6}$, and $4\frac{7}{10}$.
14. Subtract $24\frac{6}{55}$ from $30\frac{1}{70}$.
15. Multiply together $6\frac{1}{3}$, $\frac{5}{42}$, $\frac{9}{38}$, and $1\frac{2}{3}$.
16. Divide $10\frac{7}{36}$ by $9\frac{1}{4}$.
17. Add together 1·025 of a minute and ·0625 of an hour, and give the answer in seconds.
18. Subtract 2·25 ounces from ·015 of a cwt.
19. Multiply ·42881 by 5·63.
20. Divide 242 by ·55.
21. Express 1*s.* 9*d.* as the decimal of three guineas.
22. In 3424768 inches how many miles, furlongs, poles, &c.?
23. If 1 cwt. 1 qr. 21 lbs. of copper cost £4 6*s.* 3*d.*, what is the price per ton?
24. If a clock is 2 minutes and a half fast at noon on the 1st of January, and gains $3\frac{1}{2}$ minutes a week, what time will it indicate at noon on January 31st?
25. At what rate per cent. per annum (simple interest) will £850 amount to £1136 17*s.* 6*d.* in $7\frac{1}{2}$ years?
26. Find (by Practice) the value of 2 bushels 1 peck 1 gallon 2 quarts at £3 16*s.* per bushel.
27. If railway fares in Prussia are only two-thirds of railway fares in England, and it costs £1 2*s.* 6*d.* to travel 180 miles in England, what will it cost to travel 160 miles in Prussia?

VI.

1. Add together $6\frac{3}{5}$, $2\frac{1}{4}$, $\frac{3}{10}$, and $2\frac{1}{2}$.
2. Subtract $22\frac{5}{13}$ from $30\frac{7}{30}$.
3. Multiply $21\frac{7}{15}$ by $4\frac{2}{7}$.
4. Divide $5\frac{1}{4}$ by $19\frac{3}{8}$.
5. Add together 42·307, ·05869, 57·933, and 439·2865.
6. Subtract 47·3825 from 150·293104.
7. Multiply 56·433 by ·0285.
8. Divide 11·83 by 26.
9. Reduce ·275 of £1 13*s.* 4*d.* to pence.
10. Reduce 1 ton 3 cwt. 2 qrs. 9 lbs. to ounces.
11. If 3 acres of land cost £465 18*s.*, how much may be bought for £6716 14*s.* 6*d.*?
12. Find the simple interest on £635 for 9 years at $3\frac{1}{4}$ per cent. per annum.
13. Add together $2\frac{1}{16}$, $5\frac{4}{9}$, $\frac{2}{3}$, and $6\frac{3}{8}$.
14. Subtract $19\frac{2}{39}$ from $45\frac{1}{60}$.
15. Multiply together $6\frac{5}{18}$, $1\frac{2}{25}$, $16\frac{2}{3}$, and $\frac{3}{4}$.
16. Divide $3\frac{9}{20}$ by $2\frac{3}{10}$.
17. Add together ·0625 of a shilling and ·0375 of a pound.
18. Subtract 2·25 pints from ·315 of a gallon.
19. Multiply ·087654 by ·385.
20. Divide 688·2 by ·555.
21. Express 4 hours as the decimal of a week.
22. In 234247 grains Troy, how many lbs., oz., dwts., &c.?
23. If 14 grains of gold cost 2*s.* $2\frac{1}{4}$*d.*, what is the price per ounce?
24. If I pay £19 13*s.* 9*d.* per annum for income-tax, being at the rate of 5*d.* in the £, what is my income?

*25. In what time will £445 amount to £486 14*s.* $4\frac{1}{2}$*d.* at $2\frac{1}{2}$ per cent. per annum, simple interest?

26. Find (by Practice) the value of 5 cwt. 3 qrs. 21 lbs. at £15 per ton.
27. The value of unwrought silver being 4*s.* 11*d.* per ounce, and the workmanship equal to $\frac{3}{5}$ of the value of the metal, what will be the whole cost of a salver weighing 45 ounces?

VII.

1. Add together $2\frac{2}{9}$, $\frac{8}{11}$, $5\frac{1}{3}$, and $\frac{7}{22}$.
2. Subtract $6\frac{5}{8}$ from $11\frac{1}{40}$.
3. Multiply $8\frac{7}{13}$ by $1\frac{2}{37}$.
4. Divide $14\frac{3}{7}$ by $9\frac{13}{21}$.
5. Add together ·05869, 57·933, 439·2865, and 37·6849.
6. Subtract 56·293104 from 400·0738.
7. Multiply ·0285 by 6·259.
8. Divide 17·6 by 275.
9. Reduce ·35 of 2 days 13 hours to minutes.
10. Reduce 2 lbs. 3 oz. 4 dwts. to grains Troy.
11. A bankrupt's debts amount to £7563 10*s.*, and his assets to £5042 6*s.* 8*d.*, what dividend can he pay?
12. Find the simple interest on £1305 15*s.* for 7 years at $4\frac{1}{3}$ per cent. per annum.
13. Add together $12\frac{3}{5}$, $1\frac{1}{4}$, $\frac{7}{10}$, and $2\frac{16}{25}$.
14. Subtract $12\frac{11}{64}$ from $19\frac{5}{432}$.
15. Multiply together $3\frac{4}{5}$, $6\frac{5}{14}$, $\frac{3}{124}$, and $2\frac{1}{3}$.
16. Divide $19\frac{13}{18}$ by $7\frac{8}{9}$.
17. Add together ·0375 of a guinea and ·435 of a crown.
18. Subtract 2·125 perches from ·425 of an acre.
19. Multiply ·004865 by 327.
20. Multiply together 7·3, ·65, and ·04.
21. Divide 238·7 by ·55.
22. Divide ·3008096 by 41·32.
23. Express 6 lbs. as the decimal of a cwt.
24. In 3234247 ounces how many tons, cwts., quarters, &c.?
25. If 37 tons 9 cwt. 3 qrs. cost £337 7*s.* 9*d.*, what is the price per ton?
26. Four reapers begin to cut a field of barley, and it is found after working for 5 days they have cut 10 acres; two additional men are then employed, who work at the same rate, and the whole is cut in 3 days more. How many acres does the field contain?

VIII.

1. Add together $1\frac{1}{3}$, $2\frac{5}{6}$, $3\frac{1}{7}$, and $\frac{9}{14}$.
2. Subtract $9\frac{5}{8}$ from $14\frac{2}{9}$.
3. Multiply $16\frac{5}{8}$ by $1\frac{7}{57}$.
4. Divide $18\frac{9}{10}$ by $16\frac{1}{5}$.
5. Add together 328·405, ·006, 1·27, and 30·567.
6. Subtract 32·816 from 40·0041.
7. Multiply 641·2 by 1·037.
8. Divide 10·209 by ·41.
9. Express ·545 of a guinea in pence and the decimal of a penny.
10. Reduce 3 qrs. 7 bushels 2 pecks to gallons.
11. If 37 articles cost £93 8*s.* 6*d.*, how many can be bought for £37 17*s.* 6*d.*?
12. Find the simple interest on £480 for 7 years at $5\frac{1}{2}$ per cent. per annum.
13. Add together $4\frac{1}{5}$, $\frac{8}{15}$, $2\frac{3}{8}$, and $1\frac{1}{4}$.
14. Subtract $13\frac{1}{14}$ from $16\frac{5}{8}$.
15. Multiply together $6\frac{11}{18}$ of $2\frac{4}{25}$, $\frac{16}{17}$, and $4\frac{3}{8}$.
16. Divide $3\frac{22}{35}$ by $2\frac{2}{7}$.
17. Add together 2·3 of a ton and ·03475 of a cwt., and give the answer in pounds, ounces, and the decimal of an ounce.
18. Subtract 18·52 of a shilling from 1·43 of a guinea.
19. Multiply 3·8517 by ·023.
20. Multiply together ·6, ·7, and ·82.
21. Divide 13·915 by ·575.
22. Divide ·1504048 by 82·64.
23. Reduce 7 oz. 11 dwts. to the decimal of 12 lbs. 7 oz. Troy.
24. If 2 cwt. 1 qr. 14 lbs. of iron cost 16*s.* $2\frac{3}{4}$*d.*, what is the price per ton?

*25. What principal is required to produce £225 1*s.* 6*d.*, at 5 per cent. simple interest, in 3 years?

26. A person invests £6231 in the 3 per cent. Consols when they are at 93. What yearly income will he derive from this investment?

IX.

1. Add together $1\frac{1}{13}$, $2\frac{2}{9}$, $1\frac{1}{26}$, and $2\frac{1}{6}$.
2. Subtract $3\frac{9}{14}$ from $4\frac{1}{21}$.
3. Multiply $14\frac{11}{15}$ by $2\frac{6}{17}$.
4. Divide $3\frac{9}{28}$ by $5\frac{19}{21}$.
5. Add together 1338·465, 1·096, 2·001, and 231·0103.
6. Subtract 13·0003 from 16·7.
7. Multiply 312·14 by 1·012.
8. Divide 9·462 by ·83.
9. Express ·315 of 13*s.* 4*d.* in pence.
10. Reduce 2 qrs. 5 bushels 3 pecks 1 gallon to quarts.
11. If 67 yards of cloth cost £36 17*s.*, how many can be bought for £111 7*s.* 6*d.*?
12. Find the simple interest on £1248 for 6 years at $3\frac{1}{4}$ per cent. per annum.
13. Add together $2\frac{1}{15}$, $3\frac{1}{8}$, $\frac{1}{20}$, and $1\frac{1}{24}$.
14. Subtract $2\frac{7}{12}$ from $5\frac{3}{16}$.
15. Multiply together $3\frac{27}{28}$, $18\frac{2}{3}$, $\frac{3}{19}$, and $7\frac{3}{5}$.
16. Divide $7\frac{21}{68}$ by $4\frac{3}{17}$.
17. Add together 2·6 of a ton and 1·3105 of a cwt., subtract 14·35 of a pound from the result, and give the answer in pounds, ounces, and the decimal of an ounce.
18. Subtract 11·351 of a shilling from 1·231 of a guinea.
19. Multiply 11·43231 by ·028.
20. Multiply together 2·1, ·03, and 10·8.
21. Divide 22287·662 by 183·74.
22. [illegible]vide 2902·11892 by 34·831.
23. [illegible]duce 5 lbs. 14 oz. 11 dwts. to the decimal of 14 lbs. 2 oz. Troy.
24. If 2 cwt. 2 qrs. 14 lbs. of copper cost £9 14*s.* 3*d.*, what is the price per ton?
25. A sum of £3024 lent at simple interest produces £378 in 5 years; what is the rate per cent.?
26. If pasturage for 28 oxen for 11 days can be obtained for £7 10*s.*, what should be paid on account of a herd of 33 feeding for 63 days?

X.

1. Add together $\frac{2}{3}$, $\frac{4}{5}$, $\frac{5}{6}$, and $\frac{8}{9}$.
2. Subtract $3\frac{1}{6}$ from $10\frac{1}{9}$.
3. Multiply $\frac{3}{13}$ by $1\frac{5}{8}$.
4. Divide $3\frac{2}{3}$ by $1\frac{1}{15}$.
5. Add together 8·376, ·06703, 37·04, and 28·064015.
6. Subtract 28·4532 from 320·6.
7. Multiply 4·2635 by ·068.
8. Divide 8·4605 by ·248 to three places of decimals.
9. Find the value of 3·75 of £2 14*s.* 8*d.*
10. In 1250784 seconds how many weeks, days, &c., are there?
11. If 3 tons of iron cost £16 10*s.*, what will be the value of 3 cwt. 2 qrs. 14 lbs.?
12. Find the simple interest on £732 for 8 years at $3\frac{1}{4}$ per cent. per annum.
13. Add together $1\frac{7}{10}$, $3\frac{7}{20}$, and $2\frac{1}{25}$.
14. Subtract $5\frac{3}{16}$ from $10\frac{1}{8}$.
15. Multiply together $1\frac{2}{9}$, $\frac{5}{12}$, $8\frac{1}{10}$, and $2\frac{1}{22}$.
16. Divide $2\frac{13}{16}$ by $4\frac{1}{8}$.
17. Add together 2·16 of a yard and ·05 of a mile.
18. Subtract 4·42 of an hour from 3·64 of a day.
19. Multiply ·506 by ·632.
20. Divide 13·915 by 575.
21. Express 13*s.* 4*d.* as the decimal of £4.
22. In 8156704 cubic inches how many cubic yards and cubic feet are there?
23. When the income-tax was reduced from 6*d.* to 4*d.* in the £, a person found that he had £42 3*s.* 9*d.* less income-tax to pay. What was his income?
24. In what time will £230 15*s.* amount to £305 14*s.* $10\frac{1}{2}$*d.* at $2\frac{1}{2}$ per cent., simple interest?
25. Find the dividend on £2560 5*s.* at 12*s.* 8*d.* in the £.
26. If 7 men received £17 10*s.* wages for 15 days, what will be the wages of 30 men for 6 days?

XI.

1. Add together $\frac{4}{7}$, $1\frac{5}{18}$, $3\frac{9}{14}$, and $\frac{23}{84}$.
2. Subtract $11\frac{7}{8}$ from $12\frac{3}{4}$.
3. Multiply $2\frac{3}{8}$ by $1\frac{7}{9}$.
4. Divide $5\frac{2}{3}$ by $\frac{7}{9}$.
5. Add together 570·638, ·80506, 5437·07, and ·0005.
6. Subtract 389·762 from 1036·5.
7. Multiply 85·7629 by 7·0063.
8. Divide 3·420 by ·45.
9. Assuming that a year = 365 days, express $\frac{5}{8}$ of a year in days and the decimal of a day.
10. In 5207653 inches how many miles, furlongs, &c.?
11. If 1 qr. 7 lbs. of iron cost 3*s.* 9*d.*, what must be paid for 87 tons 17 cwt. at the same rate?
12. Find the simple interest on £5640 for 3 years at $2\frac{1}{2}$ per cent. per annum.
13. Add together $5\frac{1}{27}$, 10, $11\frac{4}{81}$, and $\frac{11}{36}$.
14. Subtract $\frac{13}{24}$ from $4\frac{1}{6}$.
15. Multiply together $\frac{14}{15}$, $2\frac{8}{21}$, $7\frac{9}{13}$, and $22\frac{3}{4}$.
16. Divide $7\frac{5}{28}$ by $4\frac{16}{45}$.
17. Add ·0056 acres to 84·75 square yards, and give the result in square feet and the decimal of a square foot.
18. Subtract 5·017 of a gallon from 1·358 of a quarter, and give the answer in pints and the decimal fraction of a pint.
19. Multiply 709·52 by ·10506.
20. Multiply together 4·08, ·001, and ·17.
21. Divide 3010·9712 by 36200.
22. Divide ·064665 by ·0000135.
23. Express 3 qrs. 22 lbs. 6·4 oz. as the decimal of a cwt.
24. If eggs be bought at the rate of three a penny, how must they be sold to gain 40 per cent.?
25. The simple interest of £956 for $2\frac{1}{2}$ years is £119 10*s.* Required the rate per cent. per annum.

XII.

1. Add together $2\frac{3}{16}$, $\frac{5}{9}$, $1\frac{7}{12}$, and $\frac{11}{72}$.
2. Subtract $13\frac{13}{20}$ from $20\frac{1}{13}$.
3. Multiply $7\frac{5}{6}$ by $7\frac{1}{5}$.
4. Divide $8\frac{10}{11}$ by $\frac{49}{55}$.
5. Add together 68·89, 4·0255, ·00843, and 490·924.
6. Subtract 992·8456 from 1081·02.
7. Multiply 43·0276 by 4·283.
8. Divide 46·8 by 75.
9. Reduce ·073 of a cwt. to ounces and the decimal of an ounce.
10. Reduce 3 lbs. 4 oz. 5 dwts. to grains.
11. If 3 tons 4 cwt. cost 26 guineas, what will be the value of 7 cwt. 3 qrs. 14 lbs.?
12. Find the simple interest on £1270 for 4 years at $3\frac{1}{4}$ per cent. per annum.
13. Add together $8\frac{6}{7}$, $6\frac{7}{8}$, $\frac{48}{49}$, and $\frac{279}{392}$.
14. Subtract $9\frac{16}{45}$ from $30\frac{5}{16}$.
15. Multiply together $\frac{17}{22}$, $1\frac{4}{9}$, $1\frac{5}{17}$, and $\frac{3}{26}$.
16. Divide $2\frac{3}{20}$ by $6\frac{4}{35}$.
17. Add together 3·025 yards and 2·23 feet, and give the answer in inches and the decimal fraction of an inch.
18. Subtract ·432 of an acre from $2\frac{1}{2}$ roods, and give the answer in perches and the decimal fraction of a perch.
19. Multiply 56·207 by ·00159.
20. Multiply together 21·56, 3·07, and ·0011.
21. Divide 24·3 by ·0045.
22. Divide ·25273 by 1270.
23. Express $\frac{2}{3}$ of 5 pints as the decimal of a peck.
24. Three men and 6 boys working together can do a piece of work in 11 days. In how many days could 4 men do it alone, the work of 2 men being equal to that of 3 boys?
25. In what time will the simple interest on £1150 amount to £215 12*s.* 6*d.* at the rate of $2\frac{1}{2}$ per cent. per annum?

XIII.

1. Add together $1\frac{1}{17}$, $2\frac{2}{9}$, $\frac{8}{51}$, and $\frac{4}{27}$.

2. Subtract $12\frac{5}{7}$ from $14\frac{1}{23}$.

3. Multiply $10\frac{5}{18}$ by $2\frac{1}{4}$.

4. Divide $6\frac{22}{31}$ by $\frac{52}{93}$.

5. Add together 131·31, 14·9256, ·00946, and 8·0203.

6. Subtract 234·73201 from 436·237.

7. Multiply 211·0313 by 2·353.

8. Divide 11·039 by 83.

9. Reduce 1·022 of a cwt. to ounces and the decimal of an ounce.

10. Reduce 5 lbs. 2 oz. 3 dwts. to grains.

11. If 5 acres 3 roods 4 poles are valued at £1125, what will be the value of 44 acres 3 roods 1 pole of similar ground?

12. Find the simple interest on £3024 for 5 years at $2\frac{3}{4}$ per cent. per annum.

13. Add together $4\frac{5}{18}$, $3\frac{6}{7}$, $1\frac{5}{36}$, and $\frac{2}{21}$.

14. Subtract $10\frac{32}{33}$ from $15\frac{1}{17}$.

15. Multiply together $30\frac{9}{11}$, $\frac{44}{113}$, $2\frac{36}{47}$, and $\frac{1}{78}$.

16. Divide $2\frac{4}{87}$ by $1\frac{6}{29}$.

17. Add together 1·103 of a mile and 3·015 of a furlong, and give the answer in feet and the decimal fraction of a foot.

18. Subtract ·0137 of a ton from $\frac{23}{25}$ of a cwt., and give the answer in pounds and the decimal fraction of a pound.

19. Multiply 301·103 by 1·0037.

20. Multiply together 32·026, 113, and ·031.

21. Divide ·223643 by 7·43.

22. Divide ·81639 by 14100.

23. Express $\frac{2}{3}$ of $3\frac{1}{2}$ quarts as the decimal of 2 pecks.

24. If 16 tons 5 cwt. of provisions will enable a garrison of 2100 men to hold out for 13 days, what weight of food will enable 4340 men to hold out for 6 weeks?

25. What sum invested at $3\frac{1}{4}$ per cent. per annum for 4 years (simple interest) will be increased by £533 through the accumulation of interest?

XIV.

1. Add together $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{7}{24}$.
2. Subtract $2\frac{1}{4}$ from $20\frac{1}{12}$.
3. Multiply $5\frac{8}{11}$ by $4\frac{8}{9}$.
4. Divide $10\frac{12}{25}$ by $5\frac{4}{7}$.
5. Add together ·00946, 8·0203, 156·98, and 45·9876.

*6. Subtract 48·398675 from 121·0768.

7. Multiply 250·635 by 8·056.
8. Divide 14·259 by 582.
9. Reduce ·00233 of a ton to pounds and the decimal of a pound.
10. Reduce 2 acres 3 roods 4 poles 5 yards to square feet.
11. If 3 cwt. 3 qrs. cost £6 16*s*., what will be the cost of 4 cwt. 1 qr. 14 lbs.?
12. Find the simple interest on £1320 for $6\frac{1}{2}$ years at $3\frac{3}{4}$ per cent. per annum.
13. Add together $5\frac{9}{16}$, $3\frac{5}{11}$, $\frac{8}{33}$, and $2\frac{1}{4}$.
14. Subtract $6\frac{9}{14}$ from $10\frac{3}{20}$.
15. Multiply together $5\frac{4}{9}$, $1\frac{4}{7}$, $\frac{6}{11}$, and $4\frac{2}{3}$.
16. Divide $2\frac{5}{8}$ by $1\frac{3}{4}$.
17. Add together ·063 of a mile and 1·207 of a pole, and give the answer in yards and the decimal fraction of a yard.
18. Subtract ·035 of a guinea from 1·427 of a shilling, and give the answer in pence and the decimal fraction of a penny.
19. Multiply 20·3092 by ·0635.
20. Multiply together 8·803, ·065, and ·00842.
21. Divide 3217 by ·00625.
22. Divide ·9651 by 187·5.
23. Express 9*s*. $4\frac{1}{2}$*d*. as the decimal of £1 7*s*.
24. The garrison of a besieged town consists of 1000 men, with provisions that will last for 10 weeks, allowing 8 ounces per day for each man. If the garrison be reinforced with 250 more men, to what must the daily allowance be reduced in order that the provisions may last for 12 weeks?
25. In what time will £2645 amount to £3038. 8*s*. $10\frac{1}{2}$*d*. at $4\frac{1}{4}$ per cent. per annum simple interest?

XV.

1. Add together $1\frac{1}{2}$, $\frac{2}{3}$, $\frac{5}{8}$, and $2\frac{4}{11}$.
2. Subtract $5\frac{6}{7}$ from $10\frac{1}{4}$.
3. Multiply $3\frac{9}{10}$ by $5\frac{3}{13}$.
4. Divide $12\frac{3}{8}$ by $3\frac{5}{24}$.
5. Add together 81·0263, 450·97, 40·9896, and ·00239.
6. Subtract 53·962084 from 100·2970.
7. Multiply 39·0866 by 2·054.
8. Divide 116·64 by 8·64.
9. Express 1 dwt. 12 grains as the decimal of a lb. Troy.
10. Reduce 2 miles 3 furlongs 3 poles 2 yards to feet.
11. If 15 cwt. 3 qrs. $24\frac{1}{2}$ lbs. cost £9 11*s.* $7\frac{1}{2}$*d.*, what is the price per ton?
12. Find the simple interest on £2620 for $5\frac{1}{2}$ years at $4\frac{1}{4}$ per cent. per annum.
13. Add together $3\frac{5}{13}$, $2\frac{1}{7}$, $1\frac{6}{11}$, and $\frac{17}{21}$.
14. Subtract $12\frac{13}{16}$ from $20\frac{5}{14}$.
15. Multiply together $6\frac{3}{7}$, $\frac{5}{8}$, $4\frac{12}{25}$, and $\frac{2}{10}$.
16. Divide $5\frac{3}{16}$ by 29.
17. Add together ·0243 of a cwt. and ·134 of a lb., and give the answer in ounces and the decimal fraction of an ounce.
18. Subtract half a pint from ·075 of 5 gallons.
19. Multiply 230·6085 by ·00598.
20. Multiply together 9·965, ·098, and ·00253.
21. Divide 2367·4 by ·0445.
*22. Divide 4·9284 by 888.
23. Reduce ·03253 of 3 guineas to pence and the decimal of a penny.
24. If 25 men can get through a certain work in $13\frac{1}{2}$ days of 10 hours each, how many days of 9 hours will it take 30 men to do twice as much?
25. At what rate per cent. simple interest will £2345 amount to £2916 11*s.* $10\frac{1}{2}$*d.* in $6\frac{1}{2}$ years?

XVI.

1. Add together $2\frac{5}{8}$, $1\frac{3}{11}$, $5\frac{1}{24}$, and $\frac{7}{18}$.
2. Subtract $14\frac{15}{22}$ from $20\frac{6}{23}$.
3. Multiply $8\frac{5}{9}$ by $\frac{10}{11}$.
4. Divide $7\frac{3}{13}$ by $1\frac{8}{39}$.
5. Add together 14·9256, ·00946, 8·0203, and 125·687.
6. Subtract 436·937 from 501·0258.
7. Multiply 423·209 by ·00785.
8. Divide 90·915 by 209.
9. Reduce ·0925 of £1 4*s.* to pence and the decimal of a penny.
10. Reduce 3 furlongs 15 perches 2 yards 2 feet to inches.
11. If 3 tons 4 cwt. 3 qrs. of iron cost £21 0*s.* $10\frac{1}{2}$*d.*, what is the price per ton?
12. Find the simple interest on £275 for 8 years at $3\frac{1}{4}$ per cent. per annum.
13. Add together $5\frac{3}{20}$, $2\frac{6}{17}$, $\frac{13}{50}$, and $\frac{15}{34}$.
14. Subtract $18\frac{16}{19}$ from $25\frac{3}{20}$.
15. Multiply together $10\frac{3}{16}$, $23\frac{1}{3}$, $1\frac{3}{5}$, and $\frac{4}{11}$.
16. Divide $3\frac{2}{35}$ by $7\frac{1}{5}$.
17. Add together ·0735 of an acre and ·237 of a rood, and give the answer in square feet and the decimal fraction of a square foot.
18. Subtract $\frac{13}{50}$ of a mile from 3·075 of a furlong, and give the answer in yards and the decimal fraction of a yard.
19. Multiply 23·259 by 2·0869.
20. Multiply together 5·39, 21·07, and ·0013.
21. Divide 157·872 by 36·8.
22. Divide 362·97 by ·00545.
23. Express $\frac{4}{5}$ of $2\frac{1}{4}$ grains as the decimal of a lb. Troy.
24. If 6 men can copy 125 pages in 3 days, working 10 hours a day, how many men must be employed to copy 1500 pages in 20 days of 12 hours?
25. In what time will £3270 amount to £4772 3*s.* $1\frac{1}{2}$*d.* at $5\frac{1}{4}$ per cent. per annum, simple interest?

XVII.

1. Add together $5\frac{3}{10}$, $3\frac{7}{24}$, $5\frac{3}{8}$, and $\frac{14}{15}$.

2. Subtract $18\frac{38}{91}$ from $24\frac{2}{13}$.

3. Multiply $3\frac{16}{19}$ by $\frac{399}{584}$.

4. Divide $\frac{3}{68}$ by $1\frac{4}{51}$.

5. Add together 4·0255, ·60843, 4307·0582, and 327·8645.

6. Subtract 21342·071 from 30146·03527.

7. Multiply 89·8998 by 3·047.

8. Divide 6·9591555 by 843·534 to four places of decimals.

9. Reduce ·03042 of 3 tons 15 cwt. 75 lbs. to ounces and the decimal of an ounce.

10. In 34512876 square inches how many acres, roods, perches, &c.?

11. If 15 cwt. 1 qr. 14 lbs. of coal cost £1 5*s.* 7½*d.*, what is the price per ton?

12. Find the amount of £3750 in four years at 4½ per cent. simple interest.

13. Add together $3\frac{5}{17}$, $2\frac{1}{4}$, $7\frac{7}{8}$, and $5\frac{18}{51}$.

14. Subtract $54\frac{8}{9}$ from $56\frac{11}{72}$.

*15. Multiply together $\frac{13}{14}$, $\frac{17}{35}$, $\frac{17}{78}$, and $3\frac{3}{34}$.

*16. Divide $2\frac{5}{91}$ by $15\frac{9}{13}$.

17. Add together 4·302 lbs. and 17·532 dwts., and give the answer in grains and the decimal of a grain.

18. Subtract ·357 of a peck from 31·14 gallons, and give the answer in pints and the decimal of a pint.

19. Multiply 240·35 by 7·0923.

20. Multiply together ·543, 643·2, and ·3008.

21. Divide 99·721 by ·834 to three places of decimals.

22. Divide ·3121725 by 3·75.

23. Express $\frac{7}{8}$ of 16*s.* 8*d.* as the decimal of £5.

24. If 5 men, working 6 hours a day, dig a trench whose dimensions are 250 ft., 4 ft., and 5 ft. in 5 days, in how many days will 6 men, working 4 hours a day, dig a trench whose dimensions are 320 ft., 5 ft., and 5 ft.?

25. In how many years will £4350 amount to £5573 8*s.* 9*d.* if put out at 3¾ per cent. simple interest?

XVIII.

1. Add together $\frac{5}{6}$, $\frac{4}{9}$, $\frac{13}{15}$, and $3\frac{11}{24}$.

2. Subtract $2\frac{2}{3}$ from $6\frac{2}{9}$.

3. Multiply $9\frac{9}{17}$ by $2\frac{11}{54}$.

4. Divide $12\frac{6}{29}$ by $1\frac{31}{87}$.

5. Add together 8·0203, 125·687, ·00106, and ·501.

6. Subtract 741·90725 from 1875·106.

7. Multiply 87·452 by ·027.

8. Divide 71·98 by 305.

9. Express £5 12*s*. 3*d*. in pounds and the decimal fraction of a pound.

10. Find (by Practice) the value of 4 acres 3 roods 30 perches at £5 13*s*. 4*d*. per acre.

11. Reduce 429865 ounces to tons, cwts., &c.

12. Find the simple interest on £6780 for $5\frac{1}{2}$ years at $4\frac{1}{2}$ per cent. per annum.

13. Add together $1\frac{7}{18}$, $5\frac{2}{3}$, $3\frac{16}{27}$, and $4\frac{7}{54}$.

14. Subtract $8\frac{9}{17}$ from $11\frac{2}{51}$.

15. Multiply together $\frac{14}{15}$, $\frac{23}{25}$, $\frac{45}{46}$, and $\frac{19}{28}$.

16. Divide $6\frac{1}{14}$ by $\frac{17}{30}$.

17. Add together 2·325 cwts. and ·075 of a ton, and express the result in lbs. and the decimal fraction of a lb.

18. Subtract ·063 of a mile from ·747 furlongs, and give the answer in feet and the decimal fraction of a foot.

19. Multiply 7·04 by 62·098.

*20. Multiply together ·01, 6·59, and ·00053.

*21. Divide ·015267 by ·81 to five places of decimals.

22. Divide 45·0018 by ·013 to two places of decimals.

23. Express $2\frac{3}{16}$ of 104 lbs. as the decimal of a ton.

24. 7000 persons besieged in a fort held out for 3 weeks on an allowance of 15 ounces a day. How long would the fort have held out if 2000 non-combatants had been expelled at the commencement of the siege and the garrison put on a daily ration of 12 ounces?

25. At what rate per cent. would £2100 amount to £5250 in $37\frac{1}{2}$ years?

XIX.

1. Add together $\frac{1}{9}$, $\frac{1}{15}$, $\frac{1}{18}$, and $4\frac{1}{6}$.

2. Subtract $9\frac{4}{11}$ from $12\frac{1}{48}$.

3. Multiply $10\frac{3}{11}$ by $1\frac{107}{113}$.

4. Divide $9\frac{4}{17}$ by $3\frac{4}{51}$.

5. Add together 131·121, 2·86754, ·00102, and 63·2059.

6. Subtract 357·908 from 5032·07.

7. Multiply 16·5634 by 1·02.

8. Divide 108·78 by 4440.

9. Reduce ·517 of a peck to pints and the decimal fraction of a pint.

10. Find (by Practice) the dividend on £8,350 12*s.* at 12*s.* 11*d.* in the £.

11. Reduce 9786531 square feet to acres, roods, perches, &c.

12. Find the simple interest on £8,450 for 5 years at $3\frac{1}{2}$ per cent. per annum.

13. Add together $1\frac{4}{7}$, $3\frac{1}{10}$, $\frac{9}{28}$, and $7\frac{5}{16}$.

14. Subtract $10\frac{4}{9}$ from $13\frac{8}{21}$.

15. Multiply together $10\frac{1}{2}$, $\frac{8}{17}$, $2\frac{11}{20}$, and $2\frac{6}{7}$.

16. Divide $10\frac{1}{8}$ by $1\frac{11}{16}$.

17. Add together 3·346 of a lb., and 1·004 of an ounce Troy, and express the answer in grains and the decimal fraction of a grain.

18. Subtract 3·062 of an hour from 1·5347 of a day, and give the answer in minutes and the decimal fraction of a minute.

19. Multiply 46·237 by 18·45.

20. Multiply together 3·54, ·026, and 1·34.

21. Divide 548 by ·0137.

22. Divide 15·17264 by 347·2.

23. What decimal of a sovereign is ·215 of £4 16*s.*?

24. If 3 qrs. 27 lbs. 8 oz. of grain cost £17 8*s.* $9\frac{3}{4}$*d.*, how much can be bought for £8737 15*s.* $0\frac{3}{4}$*d.*?

25. In how many years will £1230 amount to £2152 10*s.* at $7\frac{1}{2}$ per cent. simple interest?

XIX.*

*1. Add together $1\frac{2}{3}$, $2\frac{3}{4}$, $3\frac{4}{5}$, and $4\frac{5}{6}$.

2. Subtract $3\frac{8}{11}$ from $7\frac{2}{5}$.

3. Multiply $6\frac{8}{9}$ by $1\frac{1}{16}$.

4. Divide $10\frac{11}{12}$ by $2\frac{5}{33}$.

5. Add together 26·9872, 324·09885, ·123, and 4·26.

6. Subtract 549·8625 from 782·296.

7. Multiply 65·0843 by ·0925.

8. Divide 21·06 by 64·8.

9. Reduce ·2349 of £1 5*s.* to pence and the decimal of a penny.

10. Find (by Practice) the value of 15 oz. 5 dwts. 6 gr. of gold at £6 10*s.* per ounce.

11. Reduce 3 tons 1 cwt. 1 qr. 11 lbs. to ounces.

12. Find the simple interest on £5860 for $4\frac{1}{4}$ years at $3\frac{1}{2}$ per cent. per annum.

13. Add together $3\frac{5}{11}$, $\frac{2}{15}$, $4\frac{16}{33}$, and $\frac{17}{60}$.

14. Subtract $12\frac{15}{19}$ from $15\frac{12}{95}$.

15. Multiply together $13\frac{4}{5}$, $\frac{17}{24}$, $2\frac{9}{23}$, and $\frac{4}{17}$.

16. Divide $3\frac{11}{12}$ by $6\frac{4}{15}$.

17. Add together ·075 of a mile and 1·326 of a furlong, and express the result in yards and the decimal fraction of a yard.

18. Subtract ·027 of an acre from 2·5 roods, and give the answer in square feet and the decimal fraction of a square foot.

19. Multiply 82·009 by 3·685.

20. Multiply together 4·073, ·0032, and ·09.

*21. Divide 129·87 by ·234.

22. Divide ·111537 by 45·9.

23. Express $\frac{1}{4}$ of $2\frac{1}{2}$ pints as the decimal of a gallon.

24. If 3 acres 1 rood 13 perches of land cost £666 5*s.*, what must be paid for 50 acres 2 roods 10 perches?

25. In what time will £3250 amount to £4527 13*s.* $1\frac{1}{2}$*d.* at $4\frac{1}{4}$ per cent. per annum simple interest?

Examination for Admission to the Royal Military College, Sandhurst.

(OPTIONAL.)

LOGARITHMS AND MENSURATION.

(*Included in the Algebra paper.*)

XX.

1. If the lengths of two straight lines be each expressed in feet and inches, show how the product of their lengths may represent superficial measurement. Apply the rule of duodecimals to find the area of a room 32 feet 8 inches long by 18 feet 4 inches wide, and explain the different terms in the product.

2. Define the logarithm of a number. If the base were 3, of what numbers are 1, 2, 3, -1, -2, -3 respectively the logarithms? Why is it found most convenient to calculate logarithms to a base 10? Of what number is ·5 the logarithm to a base 10?

Find by the aid of the tables $\frac{(24{\cdot}76)^{\frac{2}{7}}}{({\cdot}0045)^{\frac{3}{2}}}$.

3. A right angled triangle has a base of 240 feet, and the hypothenuse is 400 feet; find the area of the triangle.

4. A pyramid has a regular hexagon for its base, each side being 20 feet; find the cubical content of the pyramid, if its altitude is 12 feet.

5. The three edges of a rectangular parallelopiped that meet in an angle are respectively 25, 54, 160 feet. Find the side and diagonal of a cube which has the same volume as the parallelopiped.

6. A field has 5 sides; show by what measurements the field may be divided into triangles and its area found.

XXI.

1. In what kind of questions would you chiefly seek the assistance of logarithmic arithmetic?

Explain clearly the method of finding the number corresponding to a given logarithm which does not appear *exactly* in the tables.

2. Define a logarithm.

If $2^{2x} \cdot 7^{5x} = 1882384$, what is the value of x?

Given that $\log_{10} 2 = \cdot 3010300$ and $\log_{10} 3 = \cdot 4771213$, find $\log_{10} 3\cdot 75$, $\log_{10} \cdot 5625$, and $\log_{10} 5\sqrt[3]{\frac{3}{4}}$; find also log 25 to the base $\sqrt[3]{5}$.

3. Find the square root of $62\frac{132}{567}$; also find the number of yards in the side of a square park containing 439 acres 37 perches and $5\frac{3}{4}$ square yards.

4. The contents of two cubes are respectively 5359·375 and 5·359375 cubic feet; find the difference of the length of their edges in inches.

5. A semi-circular area, whose diameter is 15 yards, is covered with carpet two feet wide; what will it cost at 3*s.* 6*d.* per yard (allowing 11·6425 square yards for waste)? Given $\pi = 3\cdot 1416$.

6. Show how to reduce an irregular polygon of five sides to a triangle of equal area.

7. The cost of planting a hexagonal field at £5 10*s.* an acre was £7 15*s.* 7¼*d.*; find what would be the cost of fencing round it with iron railing at 2*s.* 4½*d.* per yard.

(It may be assumed that $\sqrt{3} = \frac{97}{56}$.)

XXII.

1. Define the characteristic of a logarithm, and from your definition show what are the characteristics of log 10 and log ·1 to the base $\frac{3}{2}$.

2. Given the logarithms to the base 10 of 2 and 3, find the logarithms of 72, 135, and $\sqrt[3]{\frac{1}{6}}$.

Log 2 = ·3010300.
Log 3 = ·4771213.

3. The distance between two towns is 54 miles, and the distance between their places on a map is $6\frac{3}{4}$ inches. Find the scale on which the map is drawn.

4. A cube contains 11 cubic feet 675 cubic inches. Find the length (1) of its edge, (2) of its diagonal.

5. In order to find the distance of an enemy's position from his battery, an artillery officer, riding at the rate of 10 miles an hour, goes in his reconnoitre, owing to the nature of the ground, two minutes to the east, three minutes to the north, one and a half to the north-west, and four to the north-east, from which last point the enemy's position is one mile to the north. For what range should the guns be sighted?

6. Show how to find the distance between two points, one of which is inaccessible on account of a river or some other obstacle.

7. Given log 648 = 2·81157501,
log 864 = 2·93651374,
Find log 3 and log 5.

8. An English imperial gallon is a measure which will hold 10 lbs. Avoirdupois of pure water. A cubic foot of pure water weighs 997·137 ounces Avoirdupois. The French litre is a cubic decimetre, that is, a cube on a side = 3·937 inches. Find to two places of decimals how many litres there are in a gallon.

XXIII.

1. If two cubical blocks of stone contain together 8 cubic feet, and the side of the less is to that of the greater as 3 to 4, find the side of each.

2. A rectangular garden contains 1200 square yards, and the length is to the breadth as 4 to 3; what will the fencing cost at 3*s*. 6*d*. per yard?

3. What is the weight of a hollow sphere of metal, whose inside diameter is 18 inches, and the thickness 2 inches?

Given $\pi = \frac{22}{7}$, and a cubic foot of the metal weighs 7776 oz.

4. The area of a triangle is 6 acres 2 roods and 8 perches, and a perpendicular from one angle on the base measures 524 links; find the length of the base in chains.

Given 1 chain = 100 links = 22 yards.

5. Find the area in acres of a triangle, whose sides are 25, 20, and 15 chains.

6. Explain the following terms in logarithms: base, mantissa, characteristic, modulus, and prove that $\log_a b \times \log_b a = 1$.

7. Show that $\log\left(\frac{m}{n}\right)^r = r\log m - r\log n$, and find the logarithm of ·0625 and 14·4;

having given log 2 = ·3010300, log 3 = ·4771213.

8. Given log 8·5615 = ·9325499,
and log 8·5614 = ·9325448,
find log 856·1427 and log ·008561427.

XXIV.

1. The following is an extract from a logarithm book:

N	0	1	2	3	4	5	6	7	8	9	Dif.
1905	27981950	9178	9406	9634	9862	$\bar{0}090$	$\bar{0}317$	$\bar{0}545$	$\bar{0}773$	$\bar{1}001$	228

What is the logarithm of $190\frac{1}{2}$ and of 190595·7? Divide the product of these two quantities by 19057·5, using logarithms to obtain the result to two places of decimals.

2. What are the characteristics of the logarithms of 10 and $\frac{1}{10}$ to the bases 3, $\frac{3}{2}$, $\frac{2}{3}$, and $\frac{1}{2}$ respectively?

3. What is the cube root of $\frac{1}{19·053}$ to six places of decimals, having given log 3·74408 = ·5733455, and the logarithms in Question 1?

4. An officer proceeding to India in a troopship is allowed 60 cubic feet of baggage. A lieutenant had two cases and a basket, one case being 4 feet $2\frac{1}{2}$ inches long, 2 feet $3\frac{3}{4}$ inches wide, and 2 feet $4\frac{1}{4}$ inches deep, and the other being half those dimensions in length, width, and depth, and the cylindrical basket being $3\frac{1}{2}$ feet high by 2 feet in diameter. By how much did he exceed or fall short of his allowance, actual contents being taken for the cylinder, and fractions of a cubic foot being omitted in the result?

5. The chord of an arc is 8 feet, and the height of the arc is 2 feet, what is the radius of the circle?

6. The great pyramid of Egypt was 481 feet high, when complete, and its base was 764 feet in length. Find the volume to the nearest number of cubic yards.

XXV.

1. Define the logarithm of a number to a given base, and find the logarithms of 10000 to the base 10 and to base $\sqrt[3]{10}$, and also of 2401 to the base 7, and to the base $\frac{1}{\sqrt[3]{7}}$.

2. Find from the tables $\log_{10} 487{\cdot}9634$, and, by help of the tables, find an approximate value of $(3{\cdot}7452)^{\frac{1}{3}} \div (3{\cdot}7121)^{\frac{1}{4}}$.

3. The sides of a right angled triangular field, adjacent to the right angle, are 357 feet and 476 feet; find the length of the third side of the field, and the number of square feet in its area.

4. The three different edges of a rectangular parallelopiped are respectively 3 feet, 2·52 feet, and 1·523 feet in length; find the number of cubic feet in the parallelopiped. Find also the cubic space inside a box of the same external dimensions, constructed of a material one-tenth of a foot in thickness.

5. A river 20 feet deep and 100 yards wide is flowing at the rate of 3 miles an hour; find how many tons of water run into the sea per minute, it being given that a cubic foot of water weighs 1000 ounces.

6. Assuming that the ratio of the perimeter of a circle to its diameter is 3·1416 to 1, find the volume and the surface of a cylinder, the radius of which is 4 feet and the height 100 feet.

Supposing that a wedge is cut out of this cylinder by two planes through its axis inclined to each other at an angle, which is half a right angle, what will be the volume left?

XXVI.

1. A rectangular court is 20 yards longer than it is broad, and its area is 4524 square yards; find its length and breadth.

2. The weight of two spheres, which are solid and made of the same material, are 512 lbs. and 729 lbs. respectively. If the radius of the first sphere is 16 inches, what will it cost to gild the surface of the second sphere at $1\frac{3}{4}d.$ the square inch? $(\pi = \frac{22}{7})$.

3. The perimeters of a circle, a square, and an equilateral triangle are each of them one foot; find the area of each of these figures to the nearest hundredth of a square inch.

4. The sides of a triangular field are respectively 10 chains, 8 chains, and 12 chains; find the acreage of the field and the perpendicular distance of its longest side from the opposite corner.

5. A cubical cistern contains, when completely full, 2000 cubic feet of water; find the length of one of its sides to the nearest tenth of an inch.

6. Define the logarithm of a given number to a given base. The logarithm of 2 to base 10 is ·30103; find the logarithms of $2^{-\frac{1}{10}}$, of ·002, of $5^{-\frac{1}{6}}$, and of 6250.

7. Prove that the logarithm of the product of two factors is the sum of the logarithms of the two factors.

Solve the equation $2^x = 5$.

8. The mantissæ of the logarithms of 79531 and 79532 are respectively ·9005364 and ·9005419; find the logarithm of 795·314, and find the number of which the logarithm is $\bar{2}.900539$.

XXVII.

1. The sides of three cubes have equal differences, their sum is 15 inches, and the solid content of the three together is 495 cubic inches; required the side of each.

2. Given $\log 8{\cdot}1213 = {\cdot}9096256$, write down the logarithms of 81·213, 812·13, 81213, and ·081213.

3. Given $\log 20 = 1{\cdot}30103000$, $\log 30 = 1{\cdot}47712125$, find the logarithm of 360.

4. If the side of a cube be 2, required the side of another cube exactly double the former. Given $\log 2 = {\cdot}30103$, $\log 25 = 1{\cdot}39794$, $\log 36 = 1{\cdot}41497$.

5. Find the number of cubic feet in a room which is 36 feet long, 20 feet wide, 10 feet high to the spring of the roof, and 16 feet from the floor to the pitch of the roof.

6. How many marbles, each one inch in diameter, can be packed in a box whose internal dimensions are an exact cubic foot, and how much space will be left vacant? ($\pi = 3{\cdot}1416$.)

7. The area of a triangle is 5 acres 3 roods 5·12 perches, and its perpendicular distance measures 826 links, what will be the expense of making a ditch the whole length of its base at 2*s.* 6*d.* for every 7 yards?

8. Find the weight of a ball of ashwood whose specific gravity is $\frac{4}{5}$ that of water, the diameter of the ball being 10 inches, and the weight of a cubic foot of water being 1000 oz.

XXVIII.

1. If I pay one guinea for a cubical block of marble, of which the side is one foot, what ought I to pay for another cubical block of the same marble, of which the side is equal in length to the diagonal of the first block?

2. Determine to the nearest hundredth of an inch the radius (1) of a sphere whose volume is one cubic foot, (2) of a sphere whose surface is one square foot.

[In this and the following question $\pi = 3{\cdot}1416$.]

3. If a room be 40 feet long by 20 feet broad, and contain 12800 cubic feet, what addition will be made to its cubic contents by throwing out a semi-circular bow at one end?

4. Given a circle, show how to find the radii of the n concentric circles which divide the area of the given circle into $n+1$ equal parts.

If the radius of the given circle is 1 foot, find to the nearest hundredth of an inch the radii of the two concentric circles which divide its area into three equal parts.

5. A field is in the form of a trapezoid; its parallel sides are respectively 10 chains 30 links, and 7 chains 70 links; the distance between them is 7 chains 50 links. Find the acreage.

6. If x is the logarithm of a to the base b, what is the logarithm of a^m to the base b^n?

Write down the logarithms of 256 and ·0625 to the base $\frac{1}{2}$; and of $\frac{1}{27}$ and 81 to the base 243.

7. Given $\log 18 = 1{\cdot}2552725$, $\log 125 = 2{\cdot}0959100$, $\log 21 = 1{\cdot}3222193$, find the logarithms of the numbers from 2 to 9, inclusively.

If $\log \frac{1025}{1024} = \alpha$, and $\log 2 = \beta$, show that $\log 4100 = \alpha + 12\beta$.

8. Find the seventh root of 23, given $\log 23 = 1{\cdot}3617278$, $\log 15650 = 4{\cdot}1945143$, $\log 15651 = 4{\cdot}1945421$.

XXIX.

1. If 3 yards be taken from one side of a rectangle whose perimeter is 14 yards, and added to the other side, its area will be doubled. Find the lengths of the sides.

2. How many superficial feet of inch plank can be sawn out of a log of timber 20 feet 7 inches long, 1 foot 10 inches wide, 1 foot 8 inches deep?

The unit of length used by engineers is the chain containing 100 links, each link being 0·66 of a foot. Show that an acre contains 10 square chains, assuming 1760 yards to a linear mile, and 640 acres to a square mile.

3. Assuming that a cubic foot of water weighs 1000 oz., and that a given volume of iron weighs 7·21 times as much as the same volume of water, find the weight of a bombshell, the exterior and interior diameters being 10 and 8 inches respectively $\left(\pi = \frac{22}{7}\right)$.

4. Define a logarithm, and explain the terms, base, characteristic, mantissa, and modulus. What arithmetical calcu-

lations are facilitated by the use of logarithms? State the properties of logarithms by which this is effected.

5. Given log 2 = ·3010300 and log 3 = ·4771213, find the logs of $\sqrt{\frac{1}{2}}$, $\sqrt[3]{\frac{1}{3}}$, and $(3\frac{1}{5})^{-\frac{1}{3}}$; and find the number whose log is − 1·8753145, having given log 1·3325 = ·1246672, log 1·3326 = ·1246998.

6. The sum of £9 0*s*. 10*d*. is allowed for papering a room 27·7 feet long, 19·55 feet wide, and 12·4 feet high. How much per yard must be given for a paper 2·7 feet wide?

XXX.

1. Explain generally the use of the proportional parts as given in a table of logarithms.

Given $\log_{10}$ 31204 = 4·4942103, $\log_{10}$ 31203 = 4·4941964, construct the table for the proportional parts as given in tables corresponding to these logarithms, and hence find $\log_{10}$ 31203·25.

2. Given $\log_{10}$ 20 = 1·3010300, find $\log_{10}$ ·000125.

What is the logarithm of 243 in a system of logarithms calculated to a base 3?

Express to a base 10, with its proper characteristic, the logarithm of

$$\frac{\cdot 2 \times \cdot 4 \times \cdot 8, \text{ \&c. to 10 terms.}}{\cdot 5 \times 2\cdot 5 \times 12\cdot 5, \text{ \&c. to 6 terms.}}$$

3. On opposite sides of a base which is 120 yards long two isosceles triangles are constructed; the altitude of one triangle is double the altitude of the other, and the triangle that has the least altitude has a right angle for its angle opposite the base; find in square yards the area of the four-sided figure thus formed, and express the result also in acres, roods, &c.

4. If 30 cubic inches of gunpowder weigh one pound, what weight of gunpowder will be required to fill a cylinder of 8 inches internal diameter, and with a length of 2½ feet?

5. Find the area of the six equal faces of an hexagonal pyramid, each side of the base being 6 feet, and the perpendicular height of the pyramid being 8 feet. Find also the

cubical content of the pyramid. How must a plane be drawn parallel to the base so as to divide the pyramid into two parts whose contents shall be equal to each other?

XXXI.

1. Find, very nearly, a fourth proportional to the sixth root of 9, the fourth root of 7, and the fifth root of 5. Also compare the values of these three quantities.

Given $\log 2 = \cdot 30103$ $\log 3 = \cdot 47712$
$\log 7 = \cdot 84510$ $\log 155 \cdot 6 = 2 \cdot 19201$.

2. The outer wall of a circular stone tower, 96 feet high, is 2 feet thick, and the inner diameter is 6 feet; a winding stone staircase is built in it, the central column being 1 foot in diameter; each step is 8 inches high, and there is a headway of 8 feet between each step and the one directly above it. The central column and the surface of the steps are of dressed stone. Find the number of cubic feet of stone in the tower (including the outer wall) and its weight, one cubic foot weighing 168 lbs.; also the cost of dressing the stone at 15*d.* per superficial square foot. $\left(\pi = \frac{22}{7}\right)$.

3. Cleopatra's Needle consists approximately of a frustum of a pyramid surmounted by a smaller pyramid. If the lower base were $7\frac{1}{2}$ feet square, and the upper one $4\frac{1}{2}$ feet square, the height of the frustum being 61 feet, and of the upper pyramid $7\frac{1}{2}$ feet; find its cubical contents, and its weight, if one cubic foot weighs 170 lbs.

4. Two sides of a triangular field containing an obtuse angle are 110 and 220 yards; find the length of the third side, that the field may contain exactly an acre.

5. Find at what rate simple interest a sum of money would amount in four years to the same as it would at 5 per cent. compound interest in the same time.

XXXII.

1. Prove that $\log_a \left(\frac{m}{n}\right) = \log_a m - \log_a n$.

Having given that $\log 2 = \cdot 30103$, and $\log 7 = \cdot 845098$, find $\log 2\cdot 45$ and $\log 22\cdot 4$.

2. ABCD is a field such that the straight lines joining opposite corners A, C, and B, D, meet at right angles at F; FA, FB, FC, FD measuring 83, 97, 125, and 228 yards respectively. Find the area of the field in acres, roods, &c.

3. How many square feet of metal will be required to construct a rectangular tank (open at the top) 12 feet long, 10 broad, and 8 deep?

4. It is desired to cover a piece of ground 80 feet square by a pyramidal tent 30 feet in perpendicular height. Find the cost of the requisite quantity of canvas at 4½*d.* per square yard.

5. A solid metal sphere, 6 inches in diameter, is formed into a tube 10 inches in external diameter and 4 inches in length. Find the thickness of the tube.

6. Water is poured into a cylindrical reservoir 20 feet in diameter at the rate of 400 gallons a minute. Assuming a gallon of water to measure 277¼ cubic inches, find the rate at which the surface of the water rises in the reservoir.

Examination for Admission to the Royal Military Academy, Woolwich.

(OBLIGATORY.)

(*Great importance will be attached to accuracy in numerical results.*)

(Three hours.)

XXXIII.

1. Add together $\frac{1}{6}$ of $\frac{2}{3}$, $\frac{1}{3}$ of $\frac{2}{7}$, and $1\frac{1}{2}$ of $\frac{5}{6}$.
2. Subtract $7\frac{5}{6}$ from $20\frac{3}{10}$.
3. Multiply together $4\frac{2}{3}$, $1\frac{5}{13}$, $\frac{26}{49}$, and $1\frac{7}{72}$.
4. Divide $2\frac{7}{16}$ by $3\frac{1}{8}$.
5. Add together 12·07043, ·7131, 754·5, 6·3, and ·07385.
6. Subtract 82·6874 from 701·212.
7. Multiply ·0263 by 2·36.
8. Divide ·4336218 by 7362.
9. Reduce 16·08 pennyweights to the decimal of a pound Troy.
10. Add together $\frac{14}{15}$, $1\frac{4}{25}$, and $5\frac{3}{20}$.
11. Subtract $3\frac{9}{11}$ from $8\frac{2}{3}$.
12. Multiply together $2\frac{2}{7}$ of $1\frac{4}{11}$, $2\frac{5}{8}$ of $\frac{4}{9}$, and $3\frac{1}{2}$ of $\frac{1}{10}$.
13. Divide $4\frac{5}{9}$ by $12\frac{1}{3}$.
14. Add together 5·2 of a day and ·0265 of an hour, and give the answer in minutes and the decimal fraction of a minute.
15. Subtract 6·42 of a furlong from 3·64 of a mile, and give the answer in yards and the decimal fraction of a yard.
16. Multiply ·382 by ·148.
17. Divide 81·27 by ·481 to three places of decimals.
18. Reduce ·0325 of £5 to the decimal of £3 6*s.* 8*d.*
19. Reduce 1 mile 3 furlongs 10 poles 2 feet to feet.
20. If 1 ton 5 cwt. of iron cost £1 11*s.* 3*d.*, what will 1 cwt. 2 qrs. cost?
21. Find (by Practice) the dividend on £8976 5*s.* at 13*s.* 3*d.* in the pound.

22. Find the simple interest on £1760 for 9 years at $3\frac{3}{4}$ per cent. per annum.

23. In 3 acres 2 roods 10 square yards how many square feet?

24. If either 5 oxen or 7 horses will eat up the grass of a field in 87 days, in what time will 4 oxen and 6 horses eat up the same?

25. Find (by Practice) the value of 3 tons and 21 lbs. at £12 10*s*. per cwt.

26. Find the amount of £6500 in 3 years at 5 per cent. compound interest (neglecting fractions of a penny).

27. Compute by means of the tables the value of $\frac{(2\cdot4806)^8}{(1\cdot2701)^{10}}$ to four places of decimals.

28. Given log 2 = ·3010300, log 9 = ·9542425, find, *without using the tables*, log 5, log 6, log ·0216, and log $\sqrt[5]{\cdot375}$.

*29. Extract the square root of 3915380329 and of $83\frac{193}{529}$.

30. Find the present value of £2587 18*s*. 9*d*., due 5 years hence, at $3\frac{1}{2}$ per cent.

31. By selling goods for £817 19*s*. a person lost 9 per cent. on his outlay; find at what price he should have sold them in order to have gained $10\frac{1}{2}$ per cent.

XXXIV.

1. Add together $1\frac{4}{5}$, $2\frac{5}{6}$, and $3\frac{44}{45}$.
2. Subtract $9\frac{14}{15}$ from $11\frac{2}{7}$.
3. Multiply together $1\frac{1}{2}$, $1\frac{1}{4}$, $2\frac{1}{2}$, and $3\frac{1}{5}$.
4. Divide $2\frac{15}{19}$ by $3\frac{19}{29}$.
5. Add together 11·234, ·007, 8, 9·0008, and ·7582.
6. Subtract 25·789 from 100·081.
7. Multiply 1·2345 by 9·807.
8. Divide 4·3046721 by ·0729.
9. Express 4 oz. 6 drs. as the decimal fraction of a ton.
10. Add together $\frac{5}{11}$ of $1\frac{5}{17}$, $\frac{1}{10}$ of $\frac{37}{34}$, $5\frac{1}{2}$ of $\frac{3}{55}$ and $\frac{19\frac{6}{11}}{1\frac{1}{4}}$.
11. Subtract $\frac{1\frac{1}{16}}{3\frac{2}{5}}$ from $\frac{7}{8}$ of $1\frac{1}{2}$.
12. Multiply together $1\frac{1}{25}$ of $2\frac{2}{3}$, $1\frac{11}{64}$, and $\frac{3}{7}$ of $2\frac{2}{13}$.
13. Divide $2\frac{5}{13}$ by $2\frac{51}{52}$.

14. Add together ·7 of a league, ·7803 of a mile, ·936 of a furlong, and ·864 of a pole.

15. Multiply 3·9876 by ·05004.

16. Divide 1 by 3·1415 to four places of decimals.

17. Reduce 6 bushels 2 pecks to the decimal fraction of 2 qrs. 6 bushels.

18. Divide 18917 acres 2 roods 7 poles 7 yards 3 feet 108 inches by 54.

19. If 4 tons 2 cwt. 1 qr. cost £5 9*s.* 8*d.*, what is the cost of 1 ton 3 cwt. 2 qrs.?

20. Find (by Practice) the cost of 12345 things at £2 8*s.* $11\frac{3}{4}$*d.* each.

21. Find the simple interest on £2345 5*s.* for 4 years at $4\frac{1}{4}$ per cent. per annum.

22. In a million inches how many miles, furlongs, poles, yards, and feet?

23. If 9 men, 10 women, 11 boys do a piece of work in 64 days, in how many days will 10 men, 11 women, 12 boys do it, considering a man as equal to 3 boys, and a woman as equal to 2 boys?

24. Find the amount of £89 10*s.* in 3 years at 5 per cent. per annum compound interest.

25. Extract the square root of 64009, also of 2 and ·4 to four places of decimals.

26. If 5 horses eat 8 bushels $1\frac{2}{3}$ pecks of oats in 9 days, how much will last 18 horses $1\dot{5}$ days?

27. Compute by means of the tables $\frac{7\cdot891}{\cdot0345} \times \sqrt[7]{89312\cdot7}$.

28. In what time will a sum of money treble itself at 3 per cent. compound interest, paid annually?

Given log 3 = ·4771213 and log 103 = 2·0128372.

XXXV.

1. Add together $4\frac{2}{15}$, $1\frac{7}{8}$, and $2\frac{1}{3}$.

2. Subtract $7\frac{11}{13}$ from $10\frac{2}{17}$.

3. Multiply together $3\frac{9}{16}$, $1\frac{19}{29}$, $1\frac{6}{19}$, $2\frac{17}{33}$, and $2\frac{1}{3}$.

4. Divide $1\frac{6}{43}$ by $1\frac{15}{83}$.

5. Add together 74·36001, 2·9603, ·0013, 2·805632, and ·0000037.

6. Subtract 48·978654 from 279·018.

7. Multiply 20·6754 by ·203.

8. Divide 40·303662 by ·00542.

9. Reduce 7 lbs. 8 oz. to the decimal of 18 lbs. Avoirdupois.

10. Add together $\frac{5}{7}$ of $\frac{28}{45}$, $\frac{16}{19}$ of $2\frac{3}{8}$, and $\frac{17}{23}$ of $7\frac{2}{3}$.

11. Subtract $78\frac{31}{39}$ from $80\frac{2}{13}$.

12. Multiply together $7\frac{1}{11}$ of $\frac{33}{41}$, $\frac{7}{23}$ of $\frac{20}{21}$, $\frac{7}{8}$ of 10.

13. Divide $2\frac{7}{9}$ by $1\frac{23}{27}$.

14. Add together ·00465 of a mile and 2·745 of a furlong, and give the answer in poles and the decimal fraction of a pole.

15. Subtract ·0175 of a gallon from 4·25 of a pint, and express the answer as the decimal fraction of a bushel.

16. Multiply 2·7956 by ·08003.

17. Divide 200·1 by ·3553 to four places of decimals.

18. Reduce 13*s.* 4*d.* to the decimal of £2 6*s.* 8*d.*

19. Reduce 4 acres 3 roods 27 perches to square yards.

20. If $2\frac{1}{2}$ cwt. of coffee cost £1 9*s.* 2*d.*, what will be the price of 42 lbs.?

21. Find (by Practice) the dividend on £5608 10*s.* at 14*s.* $9\frac{1}{2}$*d.* in the £.

22. Find the simple interest on £3248 10*s.* for 5 years at $3\frac{3}{4}$ per cent. per annum.

23. In 5838297 ounces, how many tons, cwts., &c.?

24. If a garrison of 1800 men have provisions for 12 weeks, how long will the provisions last if 600 more men are introduced, but the daily allowance for each man reduced one-third?

25. Find (by Practice) the value of 9 tons 4 cwt. 3 qrs. 21 lbs. at £14 15*s.* 9*d.* per cwt.

26. Find the amount of £6845 in 3 years at 4 per cent. compound interest.

27. Extract the square root of $514\frac{185}{256}$, also the square root of 13, to three places of decimals.

28. A grocer having 1161 cwt. of sugar in store, buys 567 cwt. more at £1 19*s.* $10\frac{1}{2}$*d.* per cwt. He mixes the two together, and sells the whole at 5*d.* a pound, thus gaining 12 per cent. What was the cost per cwt. of the first lot of sugar?

29. Compute by means of the tables the value of

$$\frac{6\cdot12}{\cdot41312} \times 5\sqrt{5417\cdot17}.$$

30. Given $\log 7\cdot3 = \cdot8633229$,
$\log 1845\cdot8 = 3\cdot2661846$,
$\log 1845\cdot9 = 3\cdot2662082$.

Find the value of $\frac{1}{73^{-\frac{1}{7}}}$ to six places of decimals.

XXXVI.

1. Add together $1\frac{1}{12}$, $2\frac{3}{20}$, and $2\frac{5}{18}$.
2. Subtract $9\frac{17}{18}$ from $10\frac{1}{3}$.
3. Multiply together $\frac{13}{66}$, $3\frac{1}{5}$, $2\frac{1}{2}$, and $1\frac{16}{39}$.
4. Divide $1\frac{27}{41}$ by $\frac{34}{451}$.
5. Add together 123·478, 1·03, 12, 1·0001, and ·437.
6. Subtract 83·0007 from 334.
7. Multiply 86·35 by 1·2203.
8. Divide 43555·952 by 324·56.

*9. Express 12 oz. 8 drams as the decimal fraction of 2 cwt. 26 lbs.

10. Add together $\frac{3}{49}$ of $1\frac{3}{4}$, $\frac{2}{11}$ of $6\frac{2}{7}$, $2\frac{1}{6}$ of $2\frac{2}{5}$, and $\frac{\frac{1}{3}+\frac{1}{4}}{3\frac{1}{2}}$.

11. Subtract $\frac{\frac{7}{16}}{1\frac{3}{8}}$ from $\frac{5}{11}$ of $\frac{3}{4}$.

12. Multiply together $\frac{44}{81}$ of $9\frac{1}{10}$, $13\frac{1}{2}$, and $\frac{3}{91}$ of $\frac{9}{11}$.

13. Divide $4\frac{7}{8}$ by $1\frac{9}{56}$.

14. Add together 1·3 of a ton, ·001 of a cwt., ·93 of a quarter, and ·25 of a pound, and express the answer in pounds and the decimal fraction of a pound.

15. Multiply 101·037 by ·0173.

16. Divide ·00378 by 210.

17. Reduce 4 bushels 1 peck 1 gallon to the decimal fraction of 7 bushels.

18. Divide 26814 acres 1 rood 32 perches 0 yards 1 foot 3 inches by 72.

19. The construction of a railway 12 miles 6 furlongs 20 poles in length cost £328,000. What was the average expense per mile?

*20. Find (by Practice) the cost of 12480 things at £3 7*s.* 5¼*d.* each.

21. Find the simple interest on £3121 6*s.* for 5 years at 3¾ per cent. per annum.

22. If 45 men can excavate 2790 tons of earth in 28 days of 10 hours, in how many days will 35 men, working 12 hours per diem, do twice that amount of work?

23. Find the present value of £2315 5*s.* at 5 per cent. (compound interest) due in 3 years.

24. Extract the cube root of 30·664297; and the square root of ·7 to four places of decimals.

25. Compute by means of the tables $\frac{\sqrt[\frac{3}{2}]{5\cdot2}}{5\sqrt{11\cdot31}} \times (\frac{3}{7})^{-\frac{1}{3}}$.

26. On the birth of an infant, £1500 is invested so that it may accumulate at compound interest (3 per cent. per annum, payable half-yearly) during the child's minority; calculate by logarithms the amount at the end of the 21 years.

XXXVII.

1. Add together $5\frac{1}{2}$, $4\frac{3}{4}$, and $3\frac{15}{16}$.

2. Subtract $11\frac{7}{19}$ from $21\frac{1}{5}$.

3. Multiply together $2\frac{10}{27}$, $1\frac{23}{35}$, $\frac{28}{87}$, and $2\frac{13}{16}$.

4. Divide $4\frac{12}{25}$ by $4\frac{31}{50}$.

5. Add together 189·47132, 3·0167, ·119, 97·625, and 5·43798.

6. Subtract 25·06744 from 40·055.

7. Multiply 3·0056 by 156·25.

8. Divide 126·04745 by 3·925.

*9. Express £2 3*s.* 7½*d.* as the decimal of £5.

10. Add together $3\frac{3}{11}$ of $4\frac{2}{5}$, $2\frac{2}{45}$ of $4\frac{3}{23}$, $\frac{5}{8}$ of 122, and $\frac{1\frac{1}{6}+\frac{1}{4}}{5}$.

11. Subtract $25\frac{15}{16}$ from $\frac{12\frac{1}{2}}{\frac{48}{121}}$.

12. Multiply together $7\frac{1}{5}$ of $2\frac{1}{2}$ of $4\frac{3}{4}$, $\frac{1}{6}$ of $\frac{9}{10}$ of $\frac{4}{17}$, and $3\frac{1}{3}$ of $33\frac{1}{3}$.

13. Divide $1\frac{38}{105}$ by $1\frac{63}{91}$.

14. Add together $21\frac{8}{15}$ lbs. $8\frac{5}{24}$ oz. and $18\frac{1}{2}$ dwts., and express the answer in lbs. and the decimal fraction of 1 lb.

15. Multiply together 48·1625, ·00075, and 8000.

16. Divide 352·95624 by ·000504.

17. Reduce 4 square poles 2 yards 6 feet 108 inches to the vulgar fraction and to the decimal fraction of 4 roods 20 poles.

18. Divide 489 tons 14 cwt. 1 qr. by 84.

19. If 63 gallons 3 quarts 1 pint of wine cost £94 4*s*. $3\frac{3}{4}$*d*., what is the average price per gallon?

20. Find (by Practice) the cost of 59476 bales of goods at £15 9*s*. $10\frac{1}{2}$*d*. per bale.

21. Find the simple interest on £257 18*s*. 4*d*. for $3\frac{1}{4}$ years at 5 per cent. per annum.

22. In how many days will the same amount of work be done by 75 men, working 8 hours a day, which 100 men will do in 9 days, working 10 hours a day?

23. In what time will the compound interest on £819 4*s*. amount to £224 16*s*. 3*d*. at $6\frac{1}{4}$ per cent. per annum?

24. Find the square root of 930677049, and the cube root of 2·9 to two places of decimals.

25. Compute, by means of the tables, the value of

$$\tfrac{3}{4} \times \sqrt{24{\cdot}41} \times \frac{1}{\sqrt[3]{187}} \div {\cdot}00395.$$

26. A sum of one shilling, lent on condition of one penny interest being paid monthly, accumulates by compound interest at the same rate for twelve years; find, by logarithms, what the debt will amount to at the end of that time.

XXXVIII.

1. Add together $3\frac{3}{4}$, $4\frac{5}{6}$, and $5\frac{7}{8}$.
2. Subtract $14\frac{5}{6}$ from $21\frac{1}{9}$.
3. Multiply together $21\frac{2}{5}$, $4\frac{5}{28}$, $\frac{45}{46}$, and $1\frac{5}{107}$.
4. Divide $1\frac{29}{35}$ by $1\frac{19}{21}$.
5. Add together 15·7, 4·092, ·0075, and 3·6505.
6. Subtract 72·0975 from 73·332.
7. Multiply 22·48 by 1·125.
8. Divide 917·3245 by 65·29.
9. Express 1 oz. 5 grains as a decimal fraction of 3 oz. 4 dwts. 16 grains.

10. Add together $13\frac{1}{3}$ of $\frac{4\frac{1}{2}}{2}$, $11\frac{1}{5}$ of $5\frac{1}{8}$, $1\frac{1}{14}$ of $9\frac{1}{10}$, and $\frac{3\frac{1}{2}-2\frac{3}{4}}{\frac{5}{7}}$.

11. Subtract $\frac{9}{80}$ of $3\frac{3}{4}$ from $\frac{5\frac{5}{24}}{4\frac{4}{9}}$.

12. Multiply together $5\frac{4}{55}$, $1\frac{1}{24}$ of $1\frac{89}{115}$, and $2\frac{12}{17}$ of $\frac{55}{82}$.

13. Divide $2\frac{7}{69}$ by $\frac{29}{161}$.

14. Add together 1·1375 of a fathom, ·875 of a yard, 2.965 of a foot, and 9·75 of an inch, expressing the answer in feet and a decimal fraction of a foot.

15. Multiply together 2·56, 1·75, and ·000125.

16. Divide ·273 by ·0028.

17. Reduce 15 cwts. 2 qrs. 21 lbs. to the decimal of 2 tons 10 cwts.

18. Divide 10 miles 1 furlong 6 poles by 22.

19. An estate of 625 acres 1 rood 10 poles is bought for £7878 18*s.* 9*d.* What is the average price per acre?

20. Find (by Practice) the cost of 3257 tons of coals at £1 3*s.* 7½*d.* per ton.

21. In what time will the simple interest on £2987 10*s.* 6*d.* amount to £248 19*s.* 2½d. at 3⅓ per cent. per annum?

22. If 7 horses draw 5½ tons along 56 yards on a road in 10 minutes, how many horses will be required to draw 11 tons along 50 yards in five minutes?

23. Find the difference between the simple and compound interest on £933 6*s.* 8*d.* in 2½ years at 2½ per cent. per annum.

24. Find the cube root of 10·218313.

If the diagonal of a square is 3 feet long, find the length of each side, correct to a thousandth of an inch.

25. Compute by means of the tables the value of

$$\frac{25}{27}\sqrt[3]{34\cdot3}\div\sqrt{14\cdot4}.$$

26. If a sum of £1000 is lent on the condition that it shall bear compound interest at the rate of 5 per cent. per annum for the first 5 years, 10 per cent. per annum for the next 5 years, and afterwards 15 per cent. per annum, what will the debt amount to in 20 years?

XXXIX.

1. Add together $\frac{7}{15}$ of $12\frac{1}{7}$, $\frac{4}{37}$ of $12\frac{1}{3}$, $2\frac{1}{5}$ of $1\frac{2}{33}$, and $\dfrac{1\frac{3}{13}}{4\frac{8}{91}}$.

2. Subtract $1\frac{2}{9}$ of $5\frac{1}{11}$ from $\dfrac{25\frac{2}{3}}{4\frac{1}{12}}$.

3. Multiply together $3\frac{8}{19}$ of $2\frac{29}{52}$, $\frac{22}{49}$, and $4\frac{16}{17}$ of $6\frac{3}{8}$.

4. Divide $13\frac{5}{7}$ by $17\frac{8}{35}$.

5. Add together ·006 of a ton, ·03 of a cwt., and ·09 of 3 qrs., and express the result in lbs. and decimals of a lb.

6. Multiply 6·04 by ·35.

7. Divide 131·95 by 4·375.

8. Divide 33·511 by ·0713.

9. Express £3 6*s*. 6*d*. as a decimal fraction of 7 half crowns.

10. Reduce 2 oz. 5 dwts. 8 grains to a decimal of a pound Troy.

11. Divide 4 miles 11 poles 4 yards 1 foot 6 inches by 29.

12. A Charity distributes to an equal number of men, women, and children 10*s*., 5*s*., and 2*s*. 6*d*. respectively; if the amount distributed is £21, how many recipients are there?

*13. Find (by Practice) the dividend on £5476 10*s*. at 13*s*. 6*d*. in the pound.

14. Find the amount of £625 16*s*. 8*d*. in $5\frac{1}{2}$ years at $2\frac{3}{4}$ per cent. simple interest.

15. If a wine merchant gains 10 per cent. by selling wine at 49*s*. 6*d*. a dozen, what will he gain per cent. if he raises the price to 57*s*.?

16. Find the amount in 3 years of £433 6*s*. 8*d*. at 5 per cent. compound interest.

17. Distinguish between Interest and Discount.

What ready money will discharge a debt of £1056 18*s*. due 4 months hence, at $4\frac{7}{8}$ per cent. simple interest?

18. A man invests £700 in the 3 per Cents. at 84, but on their price rising he sells out and invests the proceeds in Railway preference shares paying 10 per cent. interest, thereby increasing his yearly income by £50. At what price did he sell out of the 3 per Cents.?

19. Show that the value of $2\cdot74\dot{9}$ of $\cdot\dot{2}\dot{5}4$ of $\cdot\dot{1}9047\dot{6}$ of £2. 5*s*. is 6 shillings.

20. Find the square root of $4\frac{93}{529}$, and the number of yards in the side of a square which contains 109 acres 3 roods 8 perches and 9 square yards.

21. How many inches are there in the diagonal of a cubic foot, and how many square inches in a superficies made by a plane through two opposite edges of the cube?

22. Having given $\log 2 = \cdot3010300$, $\log 3 = \cdot4771213$, $\log 7 = \cdot8450980$, find $\log 35$, $\log \cdot01764$, $\log \sqrt[8]{\cdot4725}$.

23. A sum of £500 is allowed to accumulate at 5 per cent. compound interest; what will it amount to at the end of 21 years? $\log 1392900 = 6\cdot1439199$.
$\log 1393000 = 6\cdot1439511$.

XL.

*1. Add together $3\frac{3}{4}$ of $\frac{5}{9}$, $\frac{11}{12}$ of $1\frac{2}{7}$, and $2\frac{1}{3}$ of $\frac{5}{7}$.

2. Subtract $1\frac{1}{9}$ of $3\frac{4}{15}$ from $\dfrac{20\frac{5}{11}}{3\frac{1}{33}}$.

3. Multiply together $4\frac{3}{14}$ of $6\frac{2}{9}$ of $\frac{25}{33}$ and $5\frac{1}{4}$ of $\frac{22}{59}$.

4. Divide $23\frac{10}{17}$ by $6\frac{5}{34}$.

5. Add together ·032 of a pound, 2·35 of a shilling, and 5·42 of a penny, and subtract ·35 of half a crown from their sum. Express the answer in pence and the decimal of a penny.

6. Multiply 8·0327 by ·00698.

7. Divide 24·495 by ·0426.

8. Divide ·414 by 34·5.

9. Reduce ·05249 of a lb. Troy to grains and the decimal of a grain.

10. Express ·45 of a perch as the decimal of an acre.

11. Divide 14 tons 19 cwt. 6 lbs. 5 oz. by 55.

12. If 5 men can hoe 10 acres of turnips in 4 days of 10 hours each, and the work of 3 men is equal to that of 5 boys in the same time, in how many days of $12\frac{1}{2}$ hours will 8 boys hoe 12 acres?

13. Find (by Practice) the dividend on £3447 15*s*. at 13*s*. 7*d*. in the £.

14. At what rate per cent. simple interest will £2640 amount to £3425 8*s*. in 7 years?

15. By selling 10 acres of land for £4699 8*s.* 3*d.* a man gained $5\frac{1}{4}$ per cent. What was the original price per acre?

16. Find the amount in 3 years of £2425 at 4 per cent. per annum compound interest (neglecting fractions of a penny).

17. Find the value in pence of $6\frac{3}{4}$ of $\frac{5\frac{5}{9} \text{ of } \frac{3}{25}}{6\frac{3}{10} \text{ of } \frac{5}{9}} \div 2\frac{1}{4}$ of ·125 of a guinea.

18. Find the value of $\cdot 12\dot{7}$ of a £ + $1\cdot 3\dot{2}\dot{4}$ of a shilling − $8\cdot\dot{6}\dot{9}$ of a penny.

19. A man invests £6104 in Consols at $95\frac{3}{8}$, and sells out when they are at $97\frac{1}{4}$. What does he gain by the transaction?

20. Find the cost of plating a cube of metal, containing 2 cubic feet 1457 cubic inches, with silver at 3*s.* 9*d.* per square foot.

21. What ready money will discharge a debt of £1056 11*s.* 10*d.* due 8 months hence at $4\frac{7}{8}$ per cent. per annum?

22. Find log 0·35 and log 38·5.

23. Find by logs the value of $\frac{\sqrt[5]{25} \times (11)^7 \times \sqrt[11]{7}}{(11)^{10}}$.

$$\left.\begin{aligned}\log\ 5 &= \cdot 6989700\\ \log\ 7 &= \cdot 8450980\\ \log\ 11 &= 1\cdot 0413927\end{aligned}\right\} \qquad \left.\begin{aligned}\log\ 1\cdot 7070 &= \cdot 2322335\\ \log\ 1\cdot 7071 &= \cdot 2322590\end{aligned}\right\}$$

XLI.

1. Add together $2\frac{1}{3}$ of $6\frac{3}{5}$, $4\frac{7}{12}$ of $\frac{\frac{3}{7}}{\frac{5}{8}}$, $6\frac{1}{4}$ of $\frac{3}{14}$, and $\frac{2\frac{1}{4}}{1\frac{3}{7}}$.

2. Subtract $\frac{9\frac{9}{10}}{12\frac{7}{15}}$ from $5\frac{3}{4}$ of $1\frac{7}{17}$.

3. Multiply together $\frac{13}{15}$, $2\frac{7}{16}$ of $3\frac{9}{25}$, and $4\frac{21}{26}$ of $\frac{10}{21}$.

4. Divide $22\frac{16}{45}$ by $2\frac{143}{180}$.

5. Add together ·027 of a ton and ·265 of a cwt., and subtract from the sum ·944 of a quarter, and express the result in pounds and the decimal of a pound.

6. Multiply 25·043 by ·237.

7. Divide 29·875 by 239.

8. Divide 259·91 by ·00395.

9. Express 10 hours 30 minutes as a decimal fraction of a week.

10. Reduce ·20735 of £1 3*s.* 3*d.* to pence and the decimal of a penny.

11. Divide 28 lbs. 3oz. 10 dwts. 3 grains by 19.

12. A can copy 150 pages in 30 hours. A and B together can copy 280 pages in 35 hours. In what time would B copy 200 pages?

13. Find (by Practice) the value of 3 cwt. 1 qr. $10\frac{1}{2}$ lbs. at £8 per ton.

14. In what time will £370 amount to £449 1*s.* 9*d.* at $2\frac{1}{4}$ per cent. per annum simple interest?

15. If $5\frac{1}{2}$ per cent. be lost by selling goods for £39 12*s.* 9*d.*, for what sum must they be sold in order to gain 5 per cent.?

16. Find the amount in three years of £2540 at 4 per cent. compound interest (neglecting fractions of a penny).

17. Find by duodecimals the cubic contents of a block of stone 3 ft. 4 in. 5 pts. long, 4 ft. 3 in. 7 pts. wide, and 1 ft. 1 in. thick. What does the answer become when expressed in cubic feet and the fraction of a cubic foot?

18. A man's income is derived from £30000 stock in the 3 per cent. Consols. He sells out of Consols at $94\frac{1}{2}$, and invests his capital in mining shares at 115, paying 4 per cent. Find to the nearest penny how his income is affected.

19. Find the value of $3\cdot\dot{6}$ of $\cdot 9\dot{5}\dot{4}$ of $\cdot\dot{4}2857\dot{1}$ of 1*s.* 6*d.*

20. Find exactly the cube root of $6\frac{539}{729}$ and the square root of 170·3025.

21. A brick being 9 in. long, $4\frac{1}{2}$ in. wide, and 3 in. thick, find the number of bricks in a solid stack measuring 30 ft. long, 16 ft. 6 in. wide, and 9 ft. 3 in. high.

22. Find log 33 and log ·00198 and the value of $2(\sqrt[10]{66})$.

23. A man puts by 2 pence at the end of the second week of the year, 4 pence at the end of the fourth week, 8 pence at the end of the sixth week, and so on each fortnight. Find by logarithms what sum he would put by for the last fortnight of the year.

Logarithms required for questions 22 and 23:

log 2 = ·3010300
log 3 = ·4771213
log 11 = 1·0413927

log 3·0407 = ·4829736
log 3·0408 = ·4829879
log 67108000 = 7·8267743
log 67109000 = 7·8267808

XLII.

1. Add together $3\frac{3}{8}$ of $\frac{5}{9}$, $5\frac{1}{13}$ of $3\frac{1}{19}$ of $\frac{5}{29}$, $\frac{1\frac{5}{8}}{2\frac{4}{11}}$, and $\frac{2\frac{5}{7}}{\frac{4}{21}}$.

2. Subtract $\frac{5}{9}$ of $1\frac{1}{20}$ from $\frac{7\frac{4}{33}}{7\frac{11}{27}}$.

3. Multiply together $8\frac{3}{14}$ of $1\frac{9}{11}$, $\frac{16}{25}$, and $3\frac{1}{9}$ of $11\frac{19}{40}$.

4. Divide $10\frac{13}{48}$ by $6\frac{6}{29}$, and the result by $5\frac{13}{96}$.

5. Add together ·083 of a week, and ·231 of a day, and subtract from the sum 8·435 of an hour, and express the result in minutes and the decimal of a minute.

6. Multiply 390·086 by ·00598.

7. Divide 32·121 by 498.

8. Divide 166·648 by ·000563.

9. Express 2 cwt. 1 qr. 7 lbs. as the decimal fraction of a ton.

10. Reduce ·49325 of £4 12*s.* 5*d.* to pence and the decimal of a penny.

11. Divide 109 acres 2 roods 15 poles 12¼ yards by 56.

12. A can do as much in 3 hours as B can do in 4, and B can do as much in 5 hours as C can do in 6. A gets through a certain work in 15 hours; how long would it have taken C?

13. Find (by Practice) the dividend on £3275 10*s.* at 14*s.* 3½*d.* in the £.

14. At what rate per cent. simple interest will £550 amount to £1060 9*s.* 4½*d.* in 11¼ years?

*15. A merchant buys certain goods at £35 per ton; at what price per lb. must he sell them in order to gain 10 per cent. on his outlay?

16. Find the amount in 3 years of £3650 at 5½ per cent. compound interest (neglecting fractions of a penny).

17. Find by duodecimals the volume of air in a room 23 feet 3 inches long, 15 feet 6 inches wide, and 18 feet 7 inches high. Express the answer also in cubic feet and the fraction of a cubic foot.

18. A man's income is derived from railway shares and the rents of houses. The former at 4½ per cent. yield £180 per annum, but the dividends falling to 3½, he increases the rents of his tenants by one-third, and by this means he

draws the same total income as before. Find the amount originally yielded by his rents and his total income.

19. Find the value of $45\cdot\dot{2}$ of $\cdot\dot{4}0\dot{4}$ of $3\dot{7}20\dot{3}$ of £3 0*s.* 9*d.*

20. Find exactly the square root of 1015·6969 and the cube root of $4\frac{1191}{2744}$.

21. In a solid stack of bricks measuring 41 feet 8 inches long, 16 feet 8 inches wide, and 14 feet 7 inches high, there are 125000 bricks; the length of each brick is 10 inches, and the thickness of each is $3\frac{1}{2}$ inches. Supposing they are all equally broad, find their breadth.

22. Find log 78 and log ·0039, and calculate the value of $6\sqrt[12]{65}$.

23. A train starts with velocity ·001 feet per second, and at the end of each second its velocity is greater by one-third than at the end of the preceding second; find by logarithms the rate of the train at the end of 25 seconds, and express the answer in miles and the decimal of a mile per hour.

Logarithms required for questions 22 and 23:

log 2 = ·3010300	log 84962 = 4·9292247
log 3 = ·4771213	log 84963 = 4·9292298
log 13 = 1·1139434	log 1328·8 = 3·1234596
	log 1328·9 = 3·1234923

XLIII.

1. Add together $8\frac{2}{3}$ of $\frac{7}{13}$, $\frac{14}{25}$ of $5\frac{5}{8}$, $\frac{16}{17}$ of $\frac{3}{5}$, and $\frac{4}{9}$ of $8\frac{1}{8}$.

2. Subtract $\dfrac{13\frac{4}{7}}{1\frac{37}{42}}$ from $3\frac{4}{7}$ of $19\frac{14}{15}$.

3. Multiply together $8\frac{8}{17}$ of $\frac{35}{54}$, and $2\frac{2}{7}$ of $3\frac{3}{8}$ of $\frac{17}{144}$.

4. Divide $19\frac{5}{13}$ by $1\frac{1}{104}$.

5. Add together 3·645 of a peck, and ·0018 of a bushel, and subtract ·09 of a quart from their sum. Express the answer in pints and the decimal of a pint.

6. Multiply 11·416 by ·0306.

7. Divide 3565·345 by 36·05.

8. Divide 98·5 by ·0000394.

9. Reduce ·0646 of a lb. Troy to grains and the decimal of a grain.

10. Express 6 hours 18 seconds as the decimal of 10 hours.

11. Divide 34 acres 2 roods 20 perches by 44.

12. If 15 men working $8\frac{1}{2}$ hours a day can in $4\frac{3}{4}$ days excavate 114 yards, the substance being of 5 degrees of hardness, how many hours a day must 25 men be employed for $4\frac{1}{4}$ days to excavate 85 yards where the material is of 11 degrees of hardness?

13. Find (by Practice) the rent of 17 acres 3 roods 25 perches at five guineas per acre.

14. At what rate per cent. simple interest will £3570 amount to £4694 11*s.* in 7 years?

15. Having two houses of equal value, by selling one of them for £127 10*s.* I find I lose 15 per cent.; for what sum must I sell the remaining one in order to gain 8 per cent. on the whole transaction?

16. Find the amount in 3 years of £2476 10*s.* at $3\frac{1}{2}$ per cent. compound interest (neglecting fractions of a penny).

17. Find the square root of 12·0409, and the cube root of $56\frac{4913}{6859}$.

18. Multiply, by duodecimals, 4 ft. 2 in. 7 pts. by 3 ft. 2 in. 3 pts., and the product by 7 ft. 5 in. Express the result in cubic feet, cubic inches, and the decimal of a cubic inch.

19. Find the value of $3{\cdot}2\dot{7}$ of 4*s.* 6*d.* + $7{\cdot}4\dot{5}\dot{4}$ of 16*s.* 6*d.* + $\cdot3\dot{5}7142\dot{8}$ of 3*s.* 6*d.*

20. Two clocks indicate the right time at noon on Monday. One gains 2 minutes in 24 hours, and the other loses 5 minutes in 48 hours. Find the time indicated by the slower when the faster points to 3 p.m. on Friday.

21. A person invests £1050 in the 3 per cents. at $82\frac{1}{2}$, which he afterwards sells out at 85, and with the proceeds buys railway 6 per cents. at 115. What is the difference in his income?

22. Find log 0·022 and log 30·25.

23. Find by logs. the value of $\dfrac{165 \times (30)^9 \times \sqrt[13]{24}}{(121)^7}$.

Logarithms required for questions 22 and 23:

log 2 = ·3010300
log 3 = ·4771213
log 11 = 1·0413927
log 10920 = 4·0382226
log 10921 = 4·0382624

Examination for Admission to the Royal Indian Engineering College, Coopers Hill.

(OBLIGATORY.)

ARITHMETIC AND MENSURATION.

(Three hours.)

XLIV.

1. Silver weighing 3 lbs. 4 dwts. is combined with 10 oz. 6 dwts. of alloy, and in the combination and manufacture $\frac{1}{15}$th of the whole weight is lost. What is the weight of the manufactured plate?

2. The distance between two telegraph posts is 18 miles 1 furlong 44 yards. How many posts will be required between them, the posts being 8 rods apart?

3. What is the remainder left when £15 10*s.* is divided by $71\frac{1}{2}$?

4. Prove that when a fraction in its lowest terms has a denominator divisible by 3 or 7, that fraction cannot be converted into a terminated decimal. Whenever the denominator is not divisible by either of these numbers can the fraction be converted into a terminated decimal?

5. Express by a recurring decimal the product of

$$2 + \tfrac{1}{2} + \tfrac{1}{6} + \tfrac{1}{24} + \tfrac{1}{120} \text{ and } \tfrac{1}{2} - \tfrac{1}{6} + \tfrac{1}{24} - \tfrac{1}{120}.$$

6. If 100 cubic feet of coals weigh as much as 126 cubic feet of water, and a cubic inch of water weighs 252·46 grains, find the weight of a cubic foot of coals in pounds and decimal parts of a pound Avoirdupois.

7. Divide 38·465 by ·0007.

8. A candidate in an examination, wherein he has to gain half marks at least to pass, has two papers of questions placed before him, of which the first carries half as many marks again as the second. On the first paper he gains marks which are ·58 of its maximum: on the second, marks which are ·43 of its maximum. Does he pass or fail?

9. An article of commerce passes successively through the hands of three dealers, each of whom in selling adds as his profit 10 per cent. of the price at which he bought. If under these circumstances goods are sold by the third dealer for £33 5*s.* 6*d.*, what did the first dealer pay for them?

10. A square has the area 87 acres 1 rood 2 perches; find the length of its side to the nearest foot.

11. In a four-sided figure, where two sides are parallel to one another, the lengths of these sides are 82 chains 4 links and 56 chains 6 links, and the perpendicular distance between them is 12 chains 10 links. What is the area of the figure in acres and decimal parts of an acre?

12. A circular plate of lead, 2 inches in thickness and 8 inches in diameter, is converted without loss of weight into spherical shot, each of ·05 inch radius. How many shot does it make?

13. To measure the plane area between a straight line and a curve whose curvature has no sudden changes, nine ordinates are drawn perpendicular to the straight line and $\frac{5}{8}$ of an inch apart, and their lengths are 4·5, 4·8, 5·1, 5·3, 5·1, 5, 4·9, 4·7, 4·2 inches.

Find the area between the first and last ordinates:

(i.) by regarding the arc of the curve between successive ordinates as coincident with its chord;

(ii.) by Simpson's rule.

XLV.

1. Add together 5, $3\frac{1}{8}$, $\frac{5}{16}$, $1\frac{5}{24}$, and $\frac{1}{5}$.

2. Subtract $8\frac{7}{17}$ from $10\frac{1}{3}$.

3. Multiply together $5\frac{1}{2}$, $\frac{2}{51}$, $\frac{5}{44}$, $1\frac{1}{16}$, and $\frac{3}{4}$.

4. Divide $7\frac{1}{8}$ by $9\frac{1}{2}$.

5. Add together 19·735, ·000786, 4732·02, and ·375799.

6. Subtract 876·93387 from 974·3216.

7. Multiply 9·238 by 65·4.

8. Divide 2·890721925 by ·03645.

9. Express 2*s.* $7\frac{1}{2}$*d.* as the decimal of £7.

10. Add together $4\frac{1}{5}$, $7\frac{13}{14}$, $9\frac{1}{10}$, $1\frac{1}{35}$.

11. Subtract $34\frac{11}{20}$ from $100\frac{3}{8}$.

12. Multiply together $8\frac{2}{9}$, $45\frac{25}{37}$, $1\frac{1}{13}$, $\frac{81}{130}$, and $2\frac{1}{6}$.

13. Divide $8\frac{4}{21}$ by $5\frac{1}{7}$.

14. Add together 1·45 of a furlong and 7·36 of a yard, and give the answer in feet and the decimal fraction of a foot.

15. Subtract 2·32 of an hour from ·325 of a week.

16. Multiply 380·72 by ·0725.

17. Divide ·7036 by ·73 to 4 places of decimals.

18. Express 1 cwt. 1 qr. 21 lbs. as the decimal of four tons and a half.

19. Find (by Practice) the dividend on £731 14*s.* 6*d.* at 14*s.* 2*d.* in the pound.

20. In 5462764 square feet how many acres, roods, &c. are there?

21. If 40 men can mow a field of 19 acres in $8\frac{1}{2}$ days of 10 hours each, how many acres can 17 men mow in 50 days of 8 hours each?

22. Find the cost of painting the 4 walls of a room at 9*d.* a square yard, the length of the room being 20 ft. $7\frac{3}{4}$ in., the breadth 15 ft. $4\frac{1}{4}$ in., and the height 12 ft. 4 in.

***23.** Multiply by duodecimals 8 ft. 2 in. 4 pts. by 4 ft. 6 in. 9 pts., and the product by 3 ft. 7 in. What does the product become when expressed in cubic feet, cubic inches, and a fraction of a cubic inch?

24. A cubic foot of a certain substance weighs 54 lbs. Avoirdupois; find the length of the side of a cube of another substance which weighs 91 lbs. 8 oz. $13\frac{1}{2}$ drams, whose specific gravity is to that of the former as 3 to 2.

25. The area of a rectangular piece of ground is 28 acres and 22 perches. What is its length, its breadth being 625 links?

26. Find the number of gallons of water which pass in 10 minutes under a bridge 17 ft. 8 in. wide, the stream being 10 ft. 11 in. deep, and its velocity 8 miles an hour.

[A gallon contains 277·72 cubic inches.]

27. The diameters of the top and bottom of a frustum of a cone are 18 inches and 27 inches respectively, and the height is 30 inches; find its volume.

28. If the weight of one cubic foot of water is 62·35 lbs. Avoirdupois, find the error in calculating the weight of 1000 cubic feet on the approximate assumption that one cubic foot weighs 1000 ounces.

29. Two opposite angles of a quadrilateral field are together equal to two right angles, and the sides measure respectively $4\frac{1}{2}$ chains, 3 chains 20 links, 2 chains 40 links, and 1 chain 90 links; find its area in acres, roods, perches, &c.

XLVI.

1. Add together 4, $1\frac{2}{5}$, $3\frac{7}{12}$, $\frac{4}{15}$, and $4\frac{1}{9}$.
2. Subtract $9\frac{3}{19}$ from $11\frac{1}{57}$.
3. Multiply together $3\frac{1}{4}$, $4\frac{1}{5}$, $\frac{2}{21}$, $3\frac{6}{13}$, and $\frac{7}{8}$.
4. Divide $10\frac{3}{11}$ by $5\frac{3}{22}$.
5. Add together 13·765, ·000135, 5613·4719, and ·500163.
6. Subtract 85·30195 from 981·061.
7. Multiply 3·001256 by ·001301.
8. Divide 4·8829899 by 43·2123.
9. Express 3*s.* $9\frac{1}{4}$*d.* as the decimal of £1 2*s.* $7\frac{1}{2}$*d.*
10. Add together $3\frac{1}{40}$, $5\frac{1}{16}$, $2\frac{3}{4}$, and $\frac{3}{5}$.
11. Subtract $12\frac{1}{15}$ from $89\frac{7}{45}$.
12. Multiply together $3\frac{12}{13}$, $\frac{26}{51}$, $\frac{7}{8}$, $9\frac{11}{14}$, and $8\frac{30}{127}$.
13. Divide $187\frac{2}{7}$ by $8\frac{45}{49}$.
14. Add together 1·085 of a pole and 3·15 of a yard, and give the answer in feet and the decimal fraction of a foot.
15. Subtract 3·012 of an hour from 1·475 of a week.
16. Multiply 1·5789 by 404·306017.
17. Divide 43·10301 by ·0034 to 4 places of decimals.
18. Express 5 qrs. 3 lbs. as the decimal of 8 cwt. 3 qrs. 21 lbs.
19. Find (by Practice) the dividend on £835 2*s.* 6*d.* at 13*s.* 10*d.* in the pound.
20. In 5462764 inches how many miles, furlongs, poles, &c., are there?
21. If 24 men in 6 days of 8 hours each can dig a trench 140 yards long, 4 yards wide, and 2 yards deep, in how many days of 9 hours each will 45 men dig a trench 3 yards wide, 4 yards deep, and 490 yards long?
22. A square field contains 3 acres 1 rood 13 perches $5\frac{3}{4}$ yards; find the length of each side.

23. Multiply by duodecimals 5 ft. 2 in. 4 pts. by 4 ft. 7 in. 9 pts. and the product by 6 ft. 7 in. What does the product become when expressed in cubic feet, cubic inches, and a fraction of a cubic inch?

24. If a pyramid is cut into two pieces by a plane parallel to the base, half-way between the vertex and the base, show that one piece is equal to seven times the other.

25. The radius of a circle is $\sqrt{2}$ inches; two parallel straight lines are drawn in it, each an inch from the centre; find the area of the part of the circle between the straight lines.

*26. A cube contains $18{\cdot}\dot{9}6\dot{2}$ cubic yards; find how many linear feet there are in an edge.

27. To measure the plane area between a straight line and a curve whose curvature has no sudden changes, nine ordinates are drawn perpendicular to the straight line and $\frac{1}{2}$ an inch apart, and their lengths are 4·4, 4·6, 5·2, 5·4, 5·1, 4·9, 4·8, 4·5, 4·3 inches.

Find the area between the first and last ordinates:

(i.) by regarding the arc of the curve between successive ordinates as coincident with its chord;

(ii.) by Simpson's rule.

28. A sphere 24 inches in diameter is divided into four parts of equal height by three parallel planes; find the volume of each part.

XLVII.

1. Add together $2\frac{1}{4}$, $3\frac{3}{5}$, $1\frac{11}{12}$, $\frac{3}{18}$, and $3\frac{1}{25}$.
2. Subtract $10\frac{2}{5}$ from $11\frac{22}{35}$.
3. Multiply together $1\frac{2}{5}$, $4\frac{3}{8}$, $\frac{3}{13}$, $2\frac{1}{10}$, and $1\frac{6}{7}$.
4. Divide $8\frac{17}{19}$ by $4\frac{1}{3}$.
5. Add together 27·347, ·000219, 1714·8342, and ·733114.
6. Subtract 203·00017 from 482·023.
7. Multiply 23·002258 by ·004003.
8. Divide 2·52145971 by 81·33741.
9. Express 14*s.* 1*d.* as the decimal of £2 3*s.* 4*d.*
10. Add together $2\frac{3}{22}$, $3\frac{5}{14}$, $1\frac{1}{11}$, and $\frac{2}{21}$.
11. Subtract $13\frac{1}{30}$ from $47\frac{3}{13}$.
12. Multiply together $1\frac{3}{11}$, $\frac{9}{14}$, $\frac{4}{7}$, $9\frac{5}{12}$, and $\frac{6}{113}$.

13. Divide $68\frac{128}{142}$ by $2\frac{13}{71}$.

14. Add together 3·075 of a furlong and 4·35 of a yard, and give the answer in feet and the decimal fraction of a foot.

15. Subtract 23·033 of a pound from 1·201 of a cwt.

16. Multiply 13·3131 by 701·302013.

17. Divide 23·746 by ·037 to three places of decimals.

18. Express 2 cwt. 1 qr. 27 lbs. as the decimal fraction of 10 cwt. 0 qrs. 5 lbs.

19. Find the cost of painting the four walls of a room at $9\frac{1}{2}$*d.* a square yard, the length of the room being 20 ft. $10\frac{1}{4}$ in., the breadth 15 ft. $1\frac{3}{4}$ in., and the height 10 ft. 3 in.

20. Define the least common multiple and the greatest common measure of two numbers. If the greatest common measure of two numbers be 51, and their least common multiple be 1785, find the numbers.

21. In 2784583 inches how many miles, furlongs, poles, &c. are there?

22. Find the length of the side of a square whose area is equal to that of a rectangle the sides of which are 94·28 and 6720 yards.

23. Find the length of the diagonal of a cubical box the solid content of which is 37 cubic feet 64 cubic inches.

24. A cubical box exactly holds 125 shot, each 3 inches in diameter; find how many cubic inches of sand would be required to fill up the interstices.

25. Divide $\cdot\dot{2}3809\dot{5}$ by $\cdot 3\dot{4}2857\dot{1}$, and extract the square root of the quotient.

26. The area of a regular hexagon is $1944\sqrt{3}$ square inches; find the length of a side.

27. The length of the sides of a quadrilateral field are as follows: AB = 300 links, BC = 400 links, CD = 6 chains 30 links, DA = 7 chains 60 links. The angle ABC is a right angle. Find the area of the field in acres, roods, and perches.

XLVIII.

1. Add together $5\frac{1}{8}$, $3\frac{3}{5}$, $2\frac{7}{12}$, $\frac{3}{20}$, and $\frac{7}{10}$.

2. Subtract $8\frac{13}{14}$ from $9\frac{1}{28}$.

3. Multiply together $\frac{3}{13}$, $2\frac{1}{10}$, $1\frac{6}{7}$, and $4\frac{1}{5}$ of $\frac{7}{8}$.

4. Divide $7\frac{14}{17}$ by $\frac{25}{34}$.

5. Add together 34·207, ·000219, 1714·8342, and ·0890653.

6. Subtract 459·0836 from 640·1302.

7. Multiply 47·00658 by ·05062.

8. Divide 986·9953 by 2·815.

9. Express 17*s.* $6\frac{3}{4}$*d.* as the decimal of £1 5*s.*

10. Add together $\frac{17}{154}$, $3\frac{5}{14}$, $1\frac{1}{11}$, and $1\frac{5}{6}$.

11. Subtract $25\frac{1}{10}$ from $36\frac{3}{8}$.

12. Multiply together $\frac{3}{7}$, $\frac{15}{26}$, $3\frac{1}{9}$, $\frac{5}{12}$, and $6\frac{6}{25}$.

13. Divide $13\frac{5}{7}$ by $7\frac{1}{5}$.

14. Add together 3·075 of a mile and 4·35 of a furlong, and give the answer in yards.

15. Subtract 10·056 of an ounce from 1·201 of a lb. Avoirdupois.

16. Multiply ·307056 by 15·006.

17. Divide 23·746 by ·0059 to three places of decimals.

18. Express 1·59685 cwt. as cwt. qrs. lbs. and ozs.

19. Find, by duodecimals, the cost of paving a court at 3*s.* 2*d.* a square foot, the length being 27 ft. 10 in., and the breadth 14 ft. 9 in.

20. How many 3-inch cubes may be cut out of a 12-inch cube.

21. If a litre is ·52 gallons, find to the nearest penny in English money the value of a pint of liquid which is worth 20 francs the litre, 1200 francs being equivalent to £49.

22. What must be the dimensions of a rectangular cistern of which the base is square and the depth equal to a quarter of a side of the base, in order that it may contain 19321 gallons of water, each gallon containing 278 cubic inches.

23. Find the length of the diagonal of a square which contains 24336 square yards.

24. What will be the expense of forming a railway 146 miles in length, at three guineas a yard?

25. Reduce 20958084 to the duodenary scale, and extract its square root in that scale.

26. The side of a regular pentagon being 10, find its area.

27. If the number of square feet on the surface of a sphere equals the number of cubic feet of its volume, what number represents its diameter?

XLIX.

1. Add together $7\frac{4}{5}$, $2\frac{1}{2}$, $\frac{4}{9}$, $7\frac{1}{8}$, and $\frac{5}{16}$.

2. Subtract $8\frac{1}{8}$ from $9\frac{1}{7}$.

3. Multiply together $2\frac{1}{5}$, $\frac{15}{22}$, $1\frac{7}{9}$, $\frac{3}{20}$, and $\frac{5}{6}$.

4. Divide $8\frac{3}{8}$ by $7\frac{1}{6}$.

5. Add together 25·069, ·50462, 1714·8342, and ·0890653.

6. Subtract 594·1307 from 601·05.

7. Multiply 540·5 by ·00169.

8. Divide ·33736854 by 25·8.

9. Express ·01573 of a guinea in pence and the decimal of a penny.

10. Add together $7\frac{3}{16}$, $1\frac{2}{15}$, $2\frac{1}{20}$, and $5\frac{7}{80}$.

11. Subtract $71\frac{13}{42}$ from $100\frac{1}{7}$.

12. Multiply together $4\frac{1}{10}$, $\frac{9}{25}$, $\frac{33}{41}$, $8\frac{2}{3}$, and $\frac{15}{143}$.

13. Divide 131 by $4\frac{1}{5}$.

14. Add together 3·075 of a cwt. and 4·35 of a lb., and give the answer in ounces and the decimal fraction of an ounce.

15. Subtract 10·056 of a yard from 1·201 of a furlong.

16. Multiply ·056379 by ·000635.

17. Divide 64·95 by ·158 to three places of decimals.

18. Express ·59685 acres in roods, poles, yards, &c.

19. The net rental of an estate, after deducting 7*d.* in the £ for income-tax and 5 per cent. on the remainder for the expenses of collecting, is £959 3*s.* 8*d.*; find the gross rental.

20. Find, by duodecimals, the cost of the lead lining of a rectangular cistern 3 ft. 2 in. long, 2 ft. 8 in. wide, and 2 ft. 6 in. deep, at 3*d.* per lb., 7 lbs. of lead covering a foot of surface.

21. Find the surface of a globe of 24 inches diameter.

22. A cylindrical vat 8 feet in diameter contains 960 gallons; what is its depth, supposing a gallon equivalent to 275 cubic inches?

23. A reservoir, containing 1200 cubic feet of water, is emptied by means of a pipe 3 inches in diameter. If the water flows out with a velocity of 2 miles an hour, how long will it take to empty it?

24. How many square feet of canvas are necessary for a conical tent whose perpendicular height is 10 feet, and diameter of its base 13 feet?

25. What length must be cut off a board $16\frac{1}{2}$ inches broad and $4\frac{1}{2}$ feet long so that the remaining part may be equal to 5 square feet?

26. The side of a regular hexagon being 10, find its area.

27. Find (1) in chains and links, (2) in yards and feet, the diameter of a circle which contains 100 acres.

[N.B.—The ratio of the diameter to the circumference of a circle should be taken as 1 : 3·1416.]

L.

1. Add together $5\frac{2}{9}$, $3\frac{7}{18}$, $2\frac{7}{36}$, $\frac{11}{12}$, and $2\frac{1}{3}$.
2. Subtract $3\frac{5}{7}$ from $4\frac{3}{8}$.
3. Multiply together $1\frac{4}{11}$, $2\frac{13}{15}$, $2\frac{25}{43}$, $1\frac{3}{17}$, and $\frac{51}{55}$.
4. Divide $10\frac{18}{23}$ by $1\frac{9}{115}$.
5. Add together 12·613, ·00175, 257·8425, and ·001345.
6. Subtract 17·9159 from 230·775.
7. Multiply 35·6 by ·01094.
8. Divide 10·8528 by 1·02.
9. Express 2 cwt. 3 qrs. 3 lbs. 8 oz. as the decimal of a ton.
10. Add together $\frac{11}{17}$, $\frac{10}{221}$, and $2\frac{7}{13}$.
11. Subtract $6\frac{5}{11}$ from $7\frac{2}{13}$.
12. Multiply together $3\frac{5}{7}$, $\frac{17}{30}$, $2\frac{11}{12}$, $\frac{50}{51}$, and $\frac{14}{15}$.
13. Divide $3\frac{14}{15}$ by $1\frac{24}{25}$.
14. Add together 5·75 of a bushel and 3·625 of a quart, and give the answer in gallons and the decimal of a gallon.
15. Subtract 7·3125 of a furlong from 1·03125 of a mile; give the answer in yards and the decimal of a yard.
16. Multiply 7·50605 by 1·0907.

17. Divide 145·0052 by ·00785.

18. Reduce 3·031 lbs. to grains and the decimal of a grain.

19. How many days of 8 hours each will it take to dig a ditch two yards wide, enclosing a square plot containing 360000 square feet, at the rate of 2½ yards in 3¾ hours?

20. Multiply by duodecimals 3 ft. 2 in. 7 pts. by 5 ft. 1 in. 3 pts., and the product by 2 ft. 7 in. Give the answer in cubic feet, cubic inches, and the fraction of a cubic inch.

21. The walls of a room 21 ft. long, 15 ft. 9 in. wide, and 11 ft. 8 in. high, are painted at an expense of £17 17*s.* 3½*d.* Find the additional expense of painting the ceiling at the same rate.

22. A ditch has to be made 360 ft. long, 10 ft. wide at the top, and 3 ft. wide at the bottom, the angle of the slope of each side being 45°. Find the number of cubic yards to be excavated.

23. A circular pond has an area of 346½ square yards. Find to the nearest penny the cost of fencing it round at 4*s.* 6*d.* per lineal yard.

24. A cubical block contains 1 yard 2 ft. 541 in. Find the cost of covering its entire surface with lead at 1*s.* 6*d.* per square foot.

25. A hemispherical punch-bowl is 5 ft. 6 in. round the brim. Supposing it to be half full, how many persons may be helped from it in hemispherical glasses 1¾ in. diameter?

HOME CIVIL SERVICE.

ADDITION.

Select *twelve* of the following columns, add up as many of them as you can in the time allowed (½ an hour), placing the answers in the spaces below the columns.

(*N.B.—You had better occupy the whole time allowed. No additional marks will be given for rapidity.*)

LI.

	(1) £	s.	d.	(2) £	s.	d.	(3) £	s.	d.
	302475	11	6	358756	3	7	538097	1	2
	95016	18	2	642935	8	1	86631	7	7
	8797	7	7	31847	1	2	267873	13	2
	817637	6	9	34232	1	11	815975	16	11
	65211	6	8	89768	12	11	54346	3	6
	69840	3	7	786178	2	4	69263	15	4
	189603	2	5	873	2	1	36197	11	7
	7624	6	2	426409	12	8	24761	18	4
	465983	17	11	373041	2	7	314197	6	5
	840732	9	2	984917	10	8	381397	7	1
	19109	19	10	74573	2	4	209172	1	9
	541263	9	5	232087	9	7	859276	3	8
	351867	4	11	318019	3	8	361211	6	7
	476385	16	3	22896	10	10	97239	2	5
	90574	2	1	741	18	2	23297	12	5
	891174	2	10	29200	7	9	566984	5	4
	23276	5	9	298772	2	6	631902	8	6
	99374	5	7	476239	15	7	621140	15	6
	98290	2	10	147732	6	2	744032	8	6
Ans.									

(4) £	s.	d.
156917	11	9
6679	14	5
16391	1	4
39142	5	2
398136	2	6
376514	10	5
29215	9	5
313257	8	11
753276	5	9
112935	8	1
274032	12	1
166197	11	7
675940	18	2
153748	2	9
691040	3	7
129374	5	7
612356	1	2
31140	15	6
34728	12	6

(5) £	s.	d.
231287	14	7
403750	5	8
76899	13	7
23109	19	10
23109	19	10
74321	18	9
11835	0	3
734321	18	9
39642	5	2
813214	2	6
239763	2	1
299653	1	8
228416	9	10
44687	17	7
91105	2	1
16391	1	4
708416	19	7
8724	2	10
310397	8	7

(6) £	s.	d.
106747	18	3
17218	9	6
326408	13	10
102376	18	3
32752	15	3
74321	18	9
810327	4	4
803421	3	6
673159	0	1
94636	1	1
42361	8	9
310397	8	7
810732	17	1
141263	9	5
83215	9	5
20242	0	7
291414	12	4
649603	2	5
93198	10	8

Ans.

(7) £	s.	d.
298772	2	6
95016	18	2
8797	7	7
817637	6	9
65211	6	8
69840	3	7
984917	10	8
631902	8	6
465983	17	11
840732	9	2
29200	7	9
54346	3	6
873	2	1
566984	5	4
24761	18	4
74573	2	4
351867	4	11
99374	5	7
98290	2	10

(8) £	s.	d.
358756	3	7
642935	8	1
891174	2	10
23276	5	9
815975	16	11
541263	9	5
97239	2	5
23297	12	5
147732	6	2
90574	2	1
361211	6	7
189603	2	5
7624	6	2
741	18	2
19109	19	10
36197	11	7
302475	11	6
538097	1	2
476385	16	3

(9) £	s.	d.
476239	15	7
86631	7	7
267873	13	2
89768	12	11
786178	2	4
69263	15	4
373041	2	7
232087	9	7
318019	3	8
22896	10	10
209172	1	9
859276	3	8
31847	1	2
34232	1	11
621140	15	6
426409	12	8
314197	6	5
381397	7	1
744032	8	6

Ans.

(10)	£	s.	d.
	156917	11	9
	6679	14	5
	16391	1	4
	39142	5	2
	398136	2	6
	376514	10	5
	403750	5	8
	76899	13	7
	753276	5	9
	112935	8	1
	675940	18	2
	153748	2	9
	313257	8	11
	239763	2	1
	94636	1	9
	803421	3	6
	673159	0	1
	813214	2	6
	34728	12	6
Ans.			

(11)	£	s.	d.
	274032	12	1
	166197	11	7
	44687	17	7
	23109	19	10
	23109	19	10
	74321	18	9
	102376	18	3
	32752	15	3
	39642	5	2
	310397	8	7
	352376	0	9
	161094	8	9
	31140	15	6
	231287	14	7
	29215	9	5
	82215	9	5
	173617	6	8
	8724	2	10
	310397	8	7
Ans.			

(12)	£	s.	d.
	439250	13	2
	14691	13	9
	4752	1	3
	11835	0	3
	734321	18	9
	74321	18	9
	810327	4	4
	42361	8	9
	299653	1	8
	291414	12	4
	129374	5	7
	612356	1	2
	810732	17	1
	141263	9	5
	691040	3	7
	708416	19	7
	41220	4	9
	71425	3	3
	93198	10	8
Ans.			

(13)	£	s.	d.
	633925	4	11
	107319	8	4
	106408	13	10
	65416	18	2
	352376	0	9
	161094	8	9
	125176	13	7
	173617	6	8
	41220	4	9
	71425	3	3
	11835	0	3
	274086	3	3
	861014	8	8
	234526	1	1
	106408	13	10
	439250	13	2
	14691	13	9
	4752	1	3
	34917	10	8
Ans.			

(14)	£	s.	d.
	789409	1	0
	610732	17	1
	107568	3	11
	191880	19	2
	181528	3	6
	63276	5	9
	15691	13	9
	120421	7	0
	131528	3	6
	231485	15	5
	19284	10	2
	19631	7	7
	111397	7	1
	6781	2	2
	793130	2	4
	236	3	1
	4636	11	4
	63177	2	5
	371140	15	6
Ans.			

(15)	£	s.	d.
	52350	11	1
	234106	7	8
	612356	1	2
	37	9	1
	134139	8	5
	531397	7	1
	12844	9	8
	41752	15	3
	810563	4	1
	209945	2	11
	234526	1	1
	836	2	7
	373041	2	7
	614275	8	2
	769276	3	8
	32752	15	3
	43109	19	10
	41047	3	2
	82971	3	2
Ans.			

(16) £	s.	d.	(17) £	s.	d.	(18) £	s.	d.
274032	12	1	436197	11	7	417116	15	7
719058	15	1	106549	3	3	38839	7	1
416109	8	9	68972	7	1	214376	15	10
72505	8	2	108106	2	2	268549	16	7
692765	1	2	935112	1	8	98132	1	6
791023	13	8	60616	3	7	234016	3	9
231902	7	6	659276	3	8	254321	18	9
348896	17	2	10847	7	7	21595	3	8
577667	13	11	10919	1	5	925978	11	1
3481	16	8	125643	9	9	941013	1	4
196408	13	10	89318	2	6	649603	2	5
105217	3	7	711015	0	1	106073	9	7
71476	3	9	739369	10	2	76752	15	3
167932	1	3	102276	3	5	87163	9	11
102376	17	1	93756	2	2	156917	11	9
463487	1	10	227	18	9	905002	0	7
81906	10	7	71834	5	9	756409	12	8
4785	13	11	83649	2	7	532121	7	6
514376	15	10	58209	1	2	761089	15	9

Ans.

(19) £	s.	d.	(20) £	s.	d.	(21) £	s.	d.
274032	12	1	376514	10	5	291414	12	4
32752	15	3	29215	9	5	649603	2	5
39642	5	2	313257	8	11	11835	0	3
39142	5	2	23109	19	10	112935	8	1
398136	2	6	23109	19	10	52350	11	1
231287	14	7	74321	18	9	234106	7	8
403750	5	8	11835	0	3	612356	1	2
94636	1	1	102376	18	3	231485	15	5
753276	5	9	16391	1	4	20242	0	7
156917	11	9	44687	17	7	228416	9	10
6679	14	5	810732	17	1	239763	2	1
166197	11	7	612356	1	2	310397	8	7
76899	13	7	708416	19	7	91105	2	1
129374	5	7	675940	18	2	31140	15	6
16391	1	4	153748	2	9	83215	9	5
803421	3	6	691040	3	7	173617	6	8
673159	0	1	141263	9	5	41220	4	9
813214	2	6	8724	2	10	71425	3	3
34728	12	6	310397	8	7	93198	10	8

Ans.

(22) £	s.	d.	(23) £	s.	d.	(24) £	s.	d.
41752	15	3	633925	4	11	734321	18	9
131528	3	6	810563	4	1	74321	18	9
125176	13	7	6781	2	2	810327	4	4
19284	10	2	191880	19	2	42361	8	9
15691	13	9	181528	3	6	134139	8	5
161094	8	9	63276	5	9	531397	7	1
37	9	1	352376	0	9	12844	9	8
299653	1	8	120421	7	0	107319	8	4
106747	18	3	789409	1	0	236	3	1
65416	18	2	610732	17	1	107568	3	11
326408	13	10	17218	9	6	783130	2	4
19631	7	7	274086	3	3	106408	13	10
861014	8	8	769276	3	8	4636	11	4
234526	1	1	32752	15	3	373041	2	7
106408	13	10	234526	1	1	111397	7	1
439250	13	2	836	2	7	209945	2	11
14691	13	9	614275	8	2	43109	19	10
4752	1	3	63177	2	5	41047	3	2
34917	10	8	371140	15	6	82971	3	2

Ans.

(25) £	s.	d.	(26) £	s.	d.	(27) £	s.	d.
120421	7	0	789409	1	0	52350	11	1
107319	8	4	610732	17	1	234106	7	8
106408	13	10	107568	3	11	612356	1	2
65416	18	2	191880	19	2	37	9	1
352376	0	9	181528	3	6	134139	8	5
161094	8	9	63276	5	9	531397	7	1
231485	15	5	15691	13	9	12844	9	8
173617	6	8	633925	4	11	41752	15	3
310397	8	7	131528	3	6	810563	4	1
810732	17	1	125176	13	7	6781	2	2
141263	9	5	19284	10	2	769276	3	8
274086	3	3	19631	7	7	209945	2	11
861014	8	8	234526	1	1	783130	2	4
234526	1	1	836	2	7	614275	8	2
106408	13	10	373041	2	7	111397	7	1
439250	13	2	236	3	1	32752	15	3
14691	13	9	4636	11	4	43109	19	10
4752	1	3	63177	2	5	41047	3	2
34917	10	8	371140	15	6	82971	3	2

Ans.

	(28) £	s.	d.	(29) £	s.	d.	(30) £	s.	d.
	274032	12	1	436197	11	7	417116	15	7
	719058	15	1	106549	3	3	38839	7	1
	416109	8	9	68972	7	1	214376	15	10
	72505	8	2	108106	2	2	268549	16	7
	692765	1	2	231902	7	6	98132	1	6
	791023	13	8	739369	10	2	234016	3	9
	935112	1	8	649603	2	5	10919	1	5
	348896	17	2	106073	9	7	21595	3	8
	941013	1	4	254321	18	9	925978	11	1
	102276	3	5	125643	9	9	60616	3	7
	196408	13	10	89318	2	6	659276	3	8
	105217	3	7	711015	0	1	10847	7	7
	71476	3	9	167932	1	3	76752	15	3
	577667	13	11	102376	17	1	87163	9	11
	3481	16	8	463487	1	10	156917	11	9
	93756	2	2	227	18	9	905002	0	7
	81906	10	7	71834	5	9	756409	12	8
	4785	13	11	83649	2	7	532121	7	6
	514376	15	10	58209	1	2	761089	15	9
Ans.									

	(31) £	s.	d.	(32) £	s.	d.	(33) £	s.	d.
	373041	2	7	381397	7	1	302475	11	6
	815975	16	11	29200	7	9	476239	15	7
	23297	12	5	54346	3	6	817637	6	9
	86631	7	7	873	2	1	89768	12	11
	65211	6	8	465983	17	11	786178	2	4
	69840	3	7	97239	2	5	69263	15	4
	189603	2	5	267873	13	2	298772	2	6
	7624	6	2	476385	16	3	232087	9	7
	538097	1	2	95016	18	2	24761	18	4
	840732	9	2	74573	2	4	314197	6	5
	642935	8	1	984917	10	8	358756	3	7
	891174	2	10	318019	3	8	566984	5	4
	23276	5	9	147732	6	2	361211	6	7
	22896	10	10	31847	1	2	351867	4	11
	90574	2	1	741	18	2	426409	12	8
	209172	1	9	19109	19	10	541263	9	5
	34232	1	11	36197	11	7	631902	8	6
	99374	5	7	8797	7	7	621140	15	6
	98290	2	10	859276	3	8	744032	8	6
Ans.									

(34)			(35)			(36)		
£	s.	d.	£	s.	d.	£	s.	d.
95016	18	2	358756	3	7	302475	11	6
19109	19	10	29200	7	9	8797	7	7
23297	12	5	54346	3	6	817637	6	2
86631	7	7	873	2	1	89768	12	11
65211	6	8	538097	1	2	786178	2	4
69840	3	7	97239	2	5	69263	15	4
189603	2	5	267873	13	2	541263	9	5
7624	6	2	373041	2	7	232087	9	7
465983	17	11	859276	3	8	74573	2	4
840732	9	2	24761	18	4	314197	6	5
642935	8	1	984917	10	8	381397	7	1
891174	2	10	318019	3	8	566984	5	4
23276	5	9	22896	10	10	361211	6	7
147732	6	2	31847	1	2	351867	4	11
90574	2	1	741	18	2	426409	12	8
209172	1	9	815975	16	11	476385	16	3
34232	1	11	298772	2	6	631902	8	6
99374	5	7	476239	15	7	621140	15	6
98290	2	10	36197	11	7	744032	8	6

Ans.

(37)			(38)			(39)		
£	s.	d.	£	s.	d.	£	s.	d.
156917	11	9	299653	1	8	734321	18	9
6679	14	5	29215	9	5	17218	9	6
16391	1	4	106747	18	3	326408	13	10
39142	5	2	23109	19	10	74321	18	9
231287	14	7	23109	19	10	313257	8	11
376514	10	5	8724	2	10	74321	18	9
94636	1	1	708416	19	7	810327	4	4
166197	11	7	76899	13	7	803421	3	6
753276	5	9	675940	18	2	673159	0	1
112935	8	1	274032	12	1	813214	2	6
102376	18	3	32752	15	3	239763	2	1
42361	8	9	398136	2	6	39642	5	2
83215	9	5	228416	9	10	44687	17	7
153748	2	9	810732	17	1	129374	5	7
691040	3	7	141263	9	5	11835	0	3
91105	2	1	310397	8	7	403750	5	8
16391	1	4	20242	0	7	291414	12	4
31140	15	6	649603	2	5	612356	1	2
34728	12	6	310397	8	7	93198	10	8

Ans.

(40) £	s.	d.	(41) £	s.	d.	(42) £	s.	d.
859276	3	8	358756	3	7	302475	11	6
29200	7	9	815975	16	11	8797	7	7
23297	12	5	54346	3	6	817637	6	9
86631	7	7	873	2	1	89768	12	11
65211	6	8	538097	1	2	786178	2	4
69840	3	7	97239	2	5	69263	15	4
189603	2	5	267873	13	2	298772	2	6
7624	6	2	373041	2	7	232087	9	7
465983	17	11	95016	18	2	74573	2	4
840732	9	2	24761	18	4	314197	6	5
642935	8	1	426409	12	8	381397	7	1
891174	2	10	318019	3	8	566984	5	4
23276	5	9	22896	10	10	361211	6	7
147732	6	2	31847	1	2	351867	4	11
90574	2	1	741	18	2	984917	10	8
209172	1	9	19109	19	10	36197	11	7
34232	1	11	541263	9	5	631902	8	6
99374	5	7	476239	15	7	621140	15	6
98290	2	10	476385	16	3	744032	8	6

Ans.

(43) £	s.	d.	(44) £	s.	d.	(45) £	s.	d.
6781	2	2	439250	13	2	531397	7	1
74321	18	9	810327	4	4	131528	3	6
181528	3	6	236	3	1	810563	4	1
352376	0	9	769276	3	8	633925	4	11
15691	13	9	708416	19	7	134139	8	5
161094	8	9	41752	15	3	191880	19	2
19284	10	2	106747	18	3	12844	9	8
42361	8	9	20242	0	7	19631	7	7
107319	8	4	326408	13	10	610732	17	1
65416	18	2	274086	3	3	125176	13	7
82971	3	2	789409	1	0	783130	2	4
43109	19	10	234526	1	1	734321	18	9
32752	15	3	107568	3	11	836	2	7
4636	11	4	106408	13	10	234526	1	1
106408	13	10	861014	8	8	111397	7	1
41220	4	9	120421	7	0	63177	2	5
14691	13	9	614275	8	2	17218	9	6
4752	1	3	209945	2	11	41047	3	2
373041	2	7	34917	10	8	371140	15	6

Ans.

(46) £	s.	d.	(47) £	s.	d.	(48) £	s.	d.
98132	1	6	719058	15	1	234016	3	9
38839	7	1	692765	1	2	532121	7	6
231902	7	6	416109	8	9	227	18	9
274032	12	1	436197	11	7	102276	3	5
93756	2	2	72505	8	2	106549	3	3
791023	13	8	89318	2	6	348896	17	2
108106	2	2	102376	17	1	10919	1	5
905002	0	7	925978	11	1	125643	9	9
756409	12	8	254321	18	9	417116	15	7
87163	9	11	60616	3	7	649603	2	5
941013	1	4	268549	16	7	21595	3	8
739369	10	2	81906	10	7	935112	1	8
71476	3	9	58209	1	2	76752	15	3
167932	1	3	214376	15	10	106073	9	7
711015	0	1	3481	16	8	196408	13	10
71834	5	9	156917	11	9	68972	7	1
105217	3	7	577667	13	11	659276	3	8
4785	13	11	83649	2	7	10847	7	7
761089	15	9	514376	15	10	463487	1	10

Ans.

(49) Add these across, placing the totals in the spaces provided.

											Totals.
1	19077	25010	18919	44358	27941	12190	8385	488	2424	2502	
2	8724	19348	31932	12788	9665	24293	7501	205	8520	5291	
3	19359	17945	5417	16228	21944	15670	2897	2657	3985	5212	
4	9572	21555	40914	10195	19482	8345	2187	6771	3535	1488	
5	18150	9505	10075	4718	12120	6259	7280	23473	3285	2469	
6	9350	36567	36095	8577	9735	11909	22279	5725	2165	2957	
7	9135	18090	18215	6495	9177	6105	862	913	4425	4869	
8	9080	18477	19425	9026	3891	12980	4525	8890	615	1689	
9	17449	16760	34209	17632	4725	6252	9687	504	2074	1314	
10	17282	8270	17568	2472	15587	16075	9720	284	290	2152	
11	12815	14175	31457	3503	7000	4323	3038	770	6291	247	
12	6653	9298	27770	4275	7079	9800	1033	323	7400	329	
13	14955	7015	4073	3710	2072	7527	2604	491	394	3001	
14	256	220	461	13668	7803	925	4145	978	1940	535	
15	876	205	14245	1350	600	3620	930	74	486	1405	
16	329	6590	1096	1452	602	7790	673	856	320	86	
17	819	9195	22916	7495	2499	1275	197	769	210	457	
18	13721	830	1649	2076	2573	2406	6225	1070	1614	892	

(50) Add these across, placing the totals in the spaces provided.

											Totals.
1	10195	25010	44358	31932	24293	12190	8385	488	205	5291	
2	8724	19348	16228	12788	9665	27941	7501	2424	5212	2502	
3	19359	21555	40914	18919	8345	2187	23473	6771	8520	3985	
4	9572	9505	19077	5417	11909	21944	15670	22279	3535	1488	
5	18150	17945	36095	9177	19482	12120	2897	2165	3285	2469	
6	9350	10075	19425	4718	9026	7280	6259	2657	5725	4425	
7	18477	18090	36567	9735	17632	12980	8890	4525	2957	4869	
8	9080	9135	17449	3891	8577	16075	913	862	615	1314	
9	18215	16760	34209	17568	6105	9720	9687	504	2152	1689	
10	9298	8270	6495	2472	7000	4725	6252	284	247	2074	
11	17282	13668	31457	3503	15587	9800	7400	323	535	290	
12	6653	7015	14175	4275	7079	2072	3038	7527	770	329	
13	14955	12815	27770	3710	925	7790	1033	491	1405	3001	
14	256	205	461	4073	4145	7803	856	978	1940	6291	
15	329	6590	14245	1096	4323	3620	2604	930	74	486	
16	876	220	1350	2076	602	600	1070	320	86	394	
17	13721	819	22916	1452	7495	2406	673	769	210	892	
18	9195	830	1649	2573	2499	1275	6225	197	1614	457	

(51) Add these across, placing the totals in the spaces provided.

											Totals.
1	19348	25010	5417	31932	24293	12190	27941	488	205	5291	
2	21555	10195	18919	12788	9665	8385	7501	2424	3985	2502	
3	19359	8724	40914	16228	21944	15670	23473	6771	8520	5212	
4	9572	9505	19077	44358	11909	8345	2187	2897	3535	1488	
5	18150	17945	36095	9177	7280	12120	22279	5725	3285	2469	
6	9350	10075	19425	4718	9735	19482	6259	2657	2165	2957	
7	18477	18090	36567	9026	17632	12980	6105	913	4425	4869	
8	9080	9135	18215	3891	8577	8890	4525	862	615	1314	
9	17449	16760	34209	6495	16075	9720	284	504	247	1689	
10	9298	8270	17568	2472	7000	4725	6252	9687	290	2074	
11	17282	14175	31457	7803	15587	9800	7400	323	535	2152	
12	6653	14955	13668	4275	7079	4145	3038	1033	770	329	
13	7015	256	27770	3710	3503	4323	7527	491	1405	3001	
14	12815	13721	461	14245	2072	925	930	978	856	6291	
15	329	6590	4073	1096	7790	3620	2604	1940	320	486	
16	876	220	1350	2076	602	600	86	74	769	394	
17	205	9195	22916	1452	7495	2499	673	1070	210	1614	
18	819	830	1649	2573	6225	1275	2406	197	892	457	

HOME CIVIL SERVICE.

PRELIMINARY TEST PAPERS.

(Three hours. At Competitions two and a half hours.)

LII.

1. Reduce 1 mile 3 furlongs 4 yards to inches.

2. If 14 tons of bar iron cost £33 19*s*., how much may be had for £97?

3. Find (by Practice) the rent of 8 acres 3 roods 10 poles at £1 17*s*. 8*d*. per acre.

4. Find the simple interest on £325 10*s*. for $2\frac{1}{2}$ years at 4 per cent. per annum.

5. Add together $1\frac{4}{9}$, $13\frac{5}{63}$, $\frac{2}{3}$, $1\frac{3}{4}$, and $\frac{5}{6}$.

6. Subtract $3\frac{1}{8}$ from $12\frac{3}{40}$.

7. Multiply $9\frac{3}{5}$ by $4\frac{1}{16}$.

8. Divide 52 by $3\frac{1}{4}$.

9. Add together ·00123, 21·4, 3605, 1·021379, and 400·006.

10. Subtract 386·12305 from 1000.

11. Multiply 3186·14 by 4·065.

12. Divide 361·25 by ·049 to four places of decimals.

13. Find the value of 32·25 of £3 6*s*. 8*d*. in pence.

14. Reduce 1 ton 3 qrs. 14 lbs. to drams.

15. If 50 workmen can do a piece of work in 12 days, how many will be required to do the same in 5 days?

16. Find (by Practice) the wages of a man for 30 weeks 2 days 3 hours at 25*s*. a week (reckoning 6 days to a week and 12 hours to a day).

*17. Find the amount of £1485 in 3 years at 5 per cent. compound interest (neglecting fractions of a penny.)

18. Add together $8\frac{3}{4}$, $\frac{13}{25}$, $1\frac{2}{15}$, and $3\frac{5}{12}$.

19. Subtract $\frac{3}{8}$ from $1\frac{13}{36}$.

20. Multiply $2\frac{3}{4}$, $21\frac{1}{7}$, $\frac{14}{33}$, and $1\frac{2}{37}$.

21. Divide $\frac{13}{16}$ by $\frac{169}{1728}$.

22. Add together 431·006501, ·00001, 804, 30·1, and 94·68125.

23. Subtract 493·601274 from 1308·00601.
24. Multiply 2·0913 by ·0016.
25. Divide 2·88241659 by ·0139.
26. Reduce 30·6125 pounds Troy to grains.
27. In 784396 pints how many bushels, gallons, &c.?
28. If 6 men can earn £30 in 21 days when the days are 12 hours long, how much can 4 men earn in 35 days, when the days are 10 hours long?
29. Find (by Practice) the dividend on £3421 9*s.* at 13*s.* 4*d.* in the £.
*30. At what rate per cent. simple interest will £1315 amount to £1545 2*s.* 6*d.* in $3\frac{1}{2}$ years?
31. Add together $\frac{2}{3}$ of $\frac{5}{8}$, $1\frac{1}{14}$ of $\frac{63}{75}$, and $\frac{7}{10}$.
32. Subtract $21\frac{1}{21}$ from $31\frac{6}{7}$.
33. Multiply together $\frac{2}{3}$ of $1\frac{1}{7}$ and $2\frac{2}{5}$ of $4\frac{3}{8}$ of $1\frac{1}{9}$.
34. Divide $40\frac{5}{7}$ by $10\frac{15}{28}$.
35. Add together 1801·60012, 12·2876, 200, 7·01, and ·0000101.
36. Subtract 13·0612967 from 14·000131.
37. Multiply 84·0126 by 1·0012.
38. Divide 5 by ·0625.
39. Express £24 12*s.* $6\frac{1}{4}$*d.* as the decimal fraction of £20.

LIII.

1. Reduce 257691 ounces to tons, cwt., &c.
2. If 5 lbs. of butter cost 8*s.* $1\frac{1}{2}$*d.*, what will 213 lbs. cost?
3. Find (by Practice) the dividend on £12135 16*s.* at 13*s.* 4*d.* in the £.
4. Find the simple interest on £960 for 12 years at $2\frac{1}{4}$ per cent. per annum.
5. Add together $3\frac{1}{42}$, $\frac{5}{21}$, $1\frac{11}{14}$, $2\frac{1}{8}$, and [illegible]
6. Subtract $4\frac{5}{8}$ from $9\frac{11}{12}$.
7. Multiply $5\frac{3}{8}$ by $3\frac{3}{11}$.
8. Divide $7\frac{1}{4}$ by $12\frac{4}{7}$.
9. Add together 8·0012, 3·0546, 789·0005, and ·000601.
10. Subtract 2·34 from 23·4.
11. Multiply 83·452 by 36·01.
12. Divide 4·65 by 812·3 to four places of decimals.

13. Express 4·238 pounds Troy in grains.

14. In 1 mile 7 furlongs and 10 poles, how many feet?

15. If either 5 oxen or 7 horses will eat up the grass of a field in 87 days, in what time will 2 oxen and 3 horses eat up the same?

16. Find (by Practice) the value of 2 tons and 21 lbs. at £12 10*s*. per cwt.

17. Find the amount of £6500 in 4 years at 3 per cent. compound interest (neglecting fractions of a penny).

18. Add together $\frac{4}{7}$, $\frac{3}{10}$, $1\frac{5}{12}$, $4\frac{17}{35}$, and $3\frac{15}{28}$.

19. Subtract $5\frac{19}{35}$ from $6\frac{3}{7}$.

20. Multiply together $\frac{3}{8}$, $6\frac{1}{2}$, $\frac{13}{14}$, and $\frac{7}{26}$.

21. Divide $\frac{14}{45}$ by $1\frac{17}{25}$.

22. Add together 153·5207, ·00705, ·2007063, 63·7, and ·194.

23. Subtract 7·2045 from 9·112.

24. Multiply 16·012 by 4·0016.

25. Divide 17·637 by 84·2 to four places of decimals.

26. Reduce £4 9*s*. 3*d.* to guineas and the decimal fraction of a guinea.

27. Reduce 3 lbs. 3 oz. 3 dwts. to grains.

28. If 12 men working 6 hours a day can finish a certain piece of work in 10 days, in how many days will 10 men working 3 hours a day get through the same work?

29. Find (by Practice) the cost of 1728 articles at £3 17*s*. 6*d.* a dozen.

30. At what rate per cent. simple interest will £3825 amount to £4972 10*s*. in 3 years?

31. Add together $3\frac{1}{4}$, $4\frac{1}{8}$, $5\frac{1}{6}$, and $\frac{3}{10}$.

32. Subtract $4\frac{1}{4}$ from $5\frac{1}{5}$.

33. Multiply together $\frac{7}{11}$, $2\frac{1}{2}$, $\frac{3}{7}$, and $10\frac{1}{2}$.

34. Divide $41\frac{5}{9}$ by $11\frac{2}{3}$.

35. Add together 16·005, 4·0206, 93·707, ·004203, and 700·251.

36. Subtract 10·697 from 120·05.

37. Multiply 737·2363 by ·6013.

38. Divide 1·006 by ·061 to four places of decimals.

39. Express 41391 seconds as the decimal fraction of 3 weeks.

LIV.

1. Reduce 3 lbs. 2 oz. 3 dwts. to grains.

2. If 37 cwt. of iron can be bought for £9 5*s.*, what is the price per ton?

3. Find (by Practice) the dividend on £1731 10*s.* at 13*s.* 3*d.* in the £.

4. Find the simple interest on £8240 for 14 months at 3 per cent. per annum.

5. Add together $2\frac{1}{3}$, $\frac{3}{16}$, $1\frac{7}{24}$, and $\frac{1}{2}$.

6. Subtract $3\frac{1}{7}$ from $7\frac{1}{13}$.

7. Multiply $2\frac{1}{3}$ by $3\frac{2}{21}$.

8. Divide $4\frac{1}{9}$ by $\frac{9}{40}$.

9. Add together 723·862, ·006203, 7, 19·634, and 32·62.

10. Subtract 8·96437 from 11·0213801.

11. Multiply 86·2034 by ·0563.

12. Divide 4·67 by 2·643 to four places of decimals.

13. Express ·0375 of a furlong in yards.

14. In 327461 pints how many quarters, bushels, pecks, &c.?

15. If 7 men can build a wall 140 feet long and 6 feet high in 12 days, in how many days will 15 men build a wall 10 feet longer and 2 feet higher than the first?

*16. Find (by Practice) the value of 1 ton 5 cwt. 2 qrs. 7 lbs. at £3 per ton.

17. Find the amount of £7205 in 3 years at 4 per cent. compound interest (neglecting fractions of a penny).

18. Add together $2\frac{1}{5}$, $\frac{3}{20}$, $4\frac{1}{15}$, and $\frac{7}{12}$.

19. Subtract $3\frac{3}{7}$ from $8\frac{1}{9}$.

20. Multiply together $2\frac{1}{4}$, $\frac{2}{7}$, $\frac{6}{13}$, and $\frac{14}{27}$.

21. Divide $9\frac{1}{8}$ by $3\frac{13}{20}$.

22. Add together 17·2398, 9·376, ·00403, 177·42, and 53·20735.

23. Subtract 16·41215 from 27·06.

24. Multiply ·0743 by ·08072.

25. Divide ·239316 by 3·256.

26. Find the value of ·0735 of £1 1*s.* in pence.

27. Reduce 3 acres 1 rood 12 perches 3 yards to square inches.

28. The telegraph posts on a railway being 33 feet apart, a passenger notices that one is passed every two seconds; at what rate per hour is the train travelling?

29. Find (by Practice) the cost of 173251 articles at 13*s.* 6*d.* per dozen.

30. At what rate per cent. will £3745 amount to £3932 5*s.* in two years (simple interest)?

31. Add together $\frac{3}{56}$, $2\frac{1}{7}$, $\frac{3}{4}$, and $2\frac{1}{8}$.

32. Subtract $8\frac{7}{8}$ from $9\frac{3}{16}$.

33. Multiply together $7\frac{1}{6}$, $\frac{5}{27}$, $\frac{9}{43}$, $\frac{3}{5}$, and 6.

34. Divide $7\frac{1}{7}$ by 8.

35. Add together 6·72358, ·076407, 23·742, 973·25, and 30·00256.

36. Subtract 70·89571 from 100·013.

37. Multiply 3·07625 by 24·32.

38. Divide 64·35016 by ·00761.

39. Express 1·76 feet as the decimal fraction of a mile.

LV.

1. In 897334 ounces, how many tons, &c.?

2. How much sugar can be bought for £374 8*s.* when 6 cwt. 2 qrs. cost £27 14*s.* 8*d.*?

3. Find (by Practice) the dividend on £1942 5*s.* at 12*s.* 7*d.* in the £.

4. Find the simple interest on £477 3*s.* 4*d.* for $4\frac{1}{2}$ years at 4 per cent.

5. Add together $7\frac{1}{4}$, $2\frac{1}{3}$, 4, and $\frac{5}{6}$.

6. Subtract $7\frac{5}{34}$ from $10\frac{2}{17}$.

7. Multiply $8\frac{4}{7}$ by $1\frac{4}{11}$.

8. Divide $21\frac{1}{4}$ by $4\frac{1}{4}$.

9. Add together 701, ·005, ·0107, 7·1, and 6·25.

10. Subtract 76·3037 from 104·012.

11. Multiply 63·04 by 7·103.

12. Divide 71·405 by 611·02 to four places of decimals.

13. Reduce 2·025 of a mile to yards.

14. In 2340820 inches how many miles, &c.?

15. How many yards of cloth at 10*s.* a yard are worth 189 yards at 6*s.* 8*d.* a yard?

16. Find (by Practice) the cost of 16 cwt. 1 qr. 19 lbs. at 35*s*. per cwt.

17. Find the amount of £880 in 4 years at $3\frac{1}{2}$ per cent. compound interest (neglecting fractions of a penny).

18. Add together $3\frac{1}{4}$, $5\frac{1}{3}$, $4\frac{1}{7}$, $\frac{2}{9}$, and $\frac{7}{8}$.

19. Subtract $2\frac{5}{8}$ from $3\frac{2}{9}$.

20. Multiply $8\frac{1}{5}$ by $\frac{8}{17}$.

21. Divide $11\frac{1}{11}$ by $\frac{61}{66}$.

22. Add together ·46832, 5·030267, 84·9736, and ·564298.

23. Subtract ·95367 from 1·83461.

24. Multiply ·50623 by 4·07804.

25. Divide ·1179256 by ·0068.

26. What is the value of 4·125 gallons?

27. Reduce 3 lbs. 6 oz. 6 dwts. to grains.

28. If railway fares in Russia are only two-thirds of railway fares in England, and it costs £1 12*s*. 6*d*. to travel in England 180 miles, what will it cost to travel in Russia 160 miles?

29. Find (by Practice) the wages of a man for 3 weeks 2 days 4 hours at £3 per week, reckoning 6 days to a week, and 12 hours to a day.

30. In what time will £350 amount to £700 at 4 per cent. simple interest?

31. Add together $\frac{1}{15}$, $\frac{1}{26}$, and $\frac{2}{39}$.

32. Subtract $5\frac{19}{20}$ from $6\frac{1}{40}$.

33. Multiply $\frac{2}{7}$, $\frac{3}{5}$, $\frac{4}{9}$, and $2\frac{5}{8}$.

34. Divide $5\frac{1}{9}$ by $20\frac{1}{9}$.

35. Add together 4·2 of 6*s*. 3*d*. and $\frac{3}{4}$ of £4 10*s*.

36. Subtract 5·179 of 1 cwt. from ·637 of 1 ton.

37. Multiply together ·007237 and ·00347.

38. Divide ·0051 by 1700.

*39. Reduce 3 furlongs 5 poles $2\frac{3}{4}$ yards to the decimal of a mile.

LVI.

1. In 123486 ounces how many tons, cwt., &c.?

2. If 170 lbs. of tea cost £2 10*s*., what will be the cost of 433 lbs.?

3. Find (by Practice) the value of 2 tons 21 lbs. of zinc at 16*s*. per cwt.

4. Find the simple interest of £3460 for 8 months at $3\frac{1}{2}$ per cent. per annum.

5. Add together $\frac{4}{5}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, and $2\frac{1}{4}$.

6. Subtract $6\frac{3}{4}$ from $13\frac{3}{8}$.

7. Multiply $3\frac{1}{4}$ by $\frac{8}{39}$.

8. Divide $4\frac{1}{8}$ by $\frac{11}{16}$.

9. Add together 430·0205, ·96743, ·006057, 16·17, and 632·199.

10. Subtract 49·0867 from 50·1966.

11. Multiply 7·357 by ·106034.

12. Divide 4·723 by 17·026 to four places of decimals.

13. Express 2·425 of a lb. Troy in grains.

*14. Reduce 1 acre 2 roods 11 perches 3 yards to square inches.

15. A besieged town, containing 45500 inhabitants has provisions for three weeks; how many must be sent away that they may be able to hold out for seven weeks?

16. Find (by Practice) the dividend on £2741 10*s.* at 12*s.* 7*d.* in the £.

17. Find the amount of £960 in three years at $4\frac{1}{4}$ per cent. compound interest (neglecting fractions of a penny).

18. Add together $\frac{1}{3}$, $\frac{1}{2}$, $\frac{1}{11}$, $\frac{1}{18}$, and $\frac{7}{22}$.

19. Subtract $8\frac{4}{11}$ from $9\frac{17}{33}$.

20. Multiply together $\frac{3}{5}$, $\frac{4}{7}$, and $1\frac{3}{4}$.

21. Divide $7\frac{3}{4}$ by $2\frac{1}{16}$.

22. Add together 7·38006, ·86541, 2·346, 800·25, ·000721, and 211·01738.

23. Subtract 27·386 from 30·02107.

24. Multiply 5·0732 by ·00732.

25. Divide ·0532 by 3·23 to four places of decimals.

26. Find the value of ·175 of £2 3*s.* 2*d.* in pence.

27. Reduce 1 lb. 2 oz. 3 dwts. to grains.

28. If 12 men working 8 hours a day take 15 days to complete a piece of work, how long will 16 boys working 10 hours a day take to do the same work, the work of one man being equal to that of two boys in the same time?

29. Find (by Practice) the cost of 7326516 articles at £1 3*s.* 6*d.* per dozen.

30. At what rate per cent. simple interest will £1650 amount to £1784 1*s.* 3*d.* in $2\frac{1}{2}$ years?

31. Add together $\frac{1}{6}$ of $\frac{2}{3}$, $\frac{1}{3}$ of $\frac{2}{7}$, and $1\frac{1}{2}$ of $\frac{5}{6}$.

32. Subtract $7\frac{1}{6}$ from $20\frac{3}{20}$.

33. Multiply together $2\frac{2}{7}$ of $1\frac{4}{11}$, $2\frac{5}{8}$ of $\frac{4}{9}$, and $3\frac{1}{2}$ of $\frac{1}{10}$.

34. Divide $2\frac{7}{16}$ by $3\frac{1}{8}$.

35. Add together 12·07043, ·7131, ·002083, 754·507, 76·30072, and ·07385.

36. Subtract 82·6874 from 701·212801.

37. Multiply ·0263 by 2·356.

38. Divide ·4336218 by 7362.

39. Reduce 16·08 pennyweights to the decimal of a pound Troy.

LVII.

1. Reduce 3 acres 1 rood 2 perches 11 square yards 2 square feet to square inches.

*2. If $3\frac{1}{2}$ lbs. of sugar cost 1*s.* $10\frac{3}{4}$*d.*, how much may be bought for £9 9*s.* 7*d.*?

3. Find (by Practice) the value of 3 oz. 5 dwts. 8 grs. of gold at £5 18*s.* 9*d.* per ounce.

4. Find the simple interest on £6870 for 73 days at $3\frac{1}{2}$ per cent. per annum.

5. Add together $\frac{7}{8}$, $3\frac{1}{4}$, $2\frac{2}{3}$, and $\frac{5}{6}$.

6. Subtract $4\frac{2}{3}$ from $12\frac{1}{8}$.

7. Multiply together $\frac{5}{7}$, $2\frac{1}{3}$, $\frac{1}{10}$, and $\frac{5}{6}$.

8. Divide $10\frac{1}{4}$ by $3\frac{1}{6}$.

9. Add together 730·07321, 5·97786, ·009763, 5490·8872, and 27.

10. Subtract 13·5863 from 20·17301.

11. Multiply 83·402 by 3·7062.

12. Divide 3846·87 by 52830 to 5 places of decimals.

13. Give the value of ·325 of a pound Troy in grains.

14. In 2426031 pints how many quarters, bushels, pecks, &c.?

15. A bankrupt's debts amount to £30732 12*s.* 6*d.*, and his assets to £10756 8*s.* $4\frac{1}{2}$*d.*, what will his creditors receive in the pound?

16. Find (by Practice) the value of 12 miles 3 furlongs 16 poles of telegraph wire at £7 per mile.

17. Find the amount of £12600 in 3 years at $2\frac{1}{2}$ per cent. per annum compound interest (neglecting fractions of a penny).

18. Add together $5\frac{1}{3}$, $\frac{3}{16}$, $\frac{1}{2}$, and $\frac{4}{5}$.

19. Subtract $9\frac{1}{9}$ from $19\frac{1}{19}$.

20. Multiply together $\frac{3}{4}$, $6\frac{2}{7}$, $1\frac{1}{9}$, and $\frac{13}{22}$.

21. Divide $7\frac{1}{3}$ by $17\frac{3}{5}$.

22. Add together 6384·27, ·00705, 67·307, 500·67293, and 2·099091.

23. Subtract 13·117 from 26·0307.

24. Multiply ·07066325 by 1·007023.

25. Divide ·1265216 by ·054.

26. Reduce 3*s.* 6*d.* to the decimal of 6*s.* 8*d.*

27. In 342076358 inches how many miles, furlongs, &c.?

28. If 30 men build a wall 175 feet long and 6 feet high in 8 days of 8 hours, how many men will be required to build a wall twice the length and twice the height in 8 days of 10 hours?

29. Find (by Practice) how much I can save per annum out of an income of £200, my daily expenses being 9*s.* $6\frac{1}{2}$*d.*

30. In what time will £670 amount to £892 15*s.* 6*d.* at $4\frac{3}{4}$ per cent. simple interest?

31. Add together $3\frac{1}{11}$, $\frac{2}{9}$, $\frac{1}{6}$, and $\frac{4}{33}$.

32. Subtract $8\frac{1}{16}$ from $13\frac{1}{40}$.

33. Multiply together $\frac{1}{13}$, $3\frac{3}{7}$, $2\frac{8}{9}$, $\frac{7}{16}$, and $\frac{1}{12}$.

34. Divide 8 by $3\frac{5}{6}$.

35. Add together 13·7 of 2*s.* 8*d.*, and 5·16 of £1 3*s.* 2*d.*, and give the answer in pence, and the decimal fraction of a penny.

36. Subtract 5·12 of an ounce from ·439 of a cwt.

37. Multiply ·00706325 by 5840·39.

38. Divide 16·3704 by 290·4 to 5 places of decimals.

39. Give the value of ·028125 of a ton in lbs.

LVIII.

1. In 4005201 grains Troy how many pounds, ounces, &c.?

2. If two tons and a half of coals cost £3 2*s.* 6*d.*, what would a hundredweight and a half cost?

3. Find (by Practice) the price of 3 quarters 2 bushels 1 gallon of corn at £2 13*s.* 4*d.* per quarter.

4. Find the simple interest on £333 10*s.* for 20 years at $3\frac{3}{4}$ per cent. per annum.

5. Add together $\frac{1}{8}$, $\frac{7}{64}$, $\frac{3}{16}$, and $\frac{1}{2}$.

6. Subtract $\frac{25}{27}$ from $2\frac{1}{3}$.

7. Multiply $\frac{2}{15}$ by $3\frac{9}{17}$.

8. Divide $\frac{7}{25}$ by $5\frac{1}{5}$.

9. Add together 407·330719, ·000093, ·02, ·4, and ·005.

10. Subtract 3·070101 from 37·005.

11. Multiply 7840·6 by 20·471.

12. Divide 7·012 by 61·25 to four places of decimals.

*13. Find the value of 2·003125 of £8.

14. In 4533206 inches how many miles, furlongs, poles, &c.?

15. If nine men can build a wall 48 ft. long and 24 ft. high in 5 days, what will be the length of a wall built by them in the same time 8 ft. in height?

16. Find (by Practice) the price of 7 oz. 13 dwts. 15 grains of gold at £3 10*s.* per ounce.

17. Find the amount of £10 in 4 years at $4\frac{1}{2}$ per cent. compound interest (neglecting fractions of a penny).

18. Add together $\frac{5}{3}$, $\frac{500}{33}$, and $\frac{13}{330}$.

19. Subtract $\frac{111}{40}$ from $3\frac{181}{360}$.

20. Multiply $\frac{53}{84}$ by $\frac{105}{1572}$.

21. Divide $3\frac{4}{7}$ by $\frac{25}{42}$.

22. Add together ·50145, ·00704, 4·00005, 8000·2, and ·000945.

23. Subtract ·44006 from 12·013.

24. Multiply ·17034 by 8572.

25. Divide 5·008 by ·049 to three places of decimals.

26. What decimal of a pound Troy is $\frac{2}{3}$ of a pennyweight?

27. Reduce 1 acre 3 roods 5 poles to square feet.

28. How much land of the yearly value of £2 13*s.* 4*d.* per acre must be given in exchange for 188 acres of land, of which the yearly value is £2 10*s.* per acre?

29. Find (by Practice) the wages of a man for 2 weeks 4 days 10 hours at 36*s.* a week, reckoning 6 days to a week and 12 hours to a day.

30. In what time will £540 amount to £712 16*s.* at 4 per cent. simple interest?

31. Add together 9, $2\frac{3}{4}$, $\frac{211}{27}$, and $\frac{1}{54}$.

32. Subtract $2\frac{1}{13}$ from $10\frac{1}{39}$.

33. Multiply together $\frac{5}{156}$, $\frac{52}{15}$, and 9.

34. Divide $300\frac{3}{8}$ by 15.
35. Add together 20134, ·1992, ·0050434, ·061, and 1.
36. Subtract ·004301 from ·0102.
37. Multiply 8892 by ·002453.
38. Divide 15483·2 by ·001125.
39. Reduce $3\frac{3}{4}$ guineas to the decimal of £2 15*s.*

LIX.

1. Reduce 976000 ounces to tons, cwt., &c.

2. If 69 lbs. of salt cost 7*s.* $2\frac{1}{4}$*d.*, how much may be bought for £5 5*s.* 5*d.*?

3. Find (by Practice) the dividend on £3173 15*s.* at 9*s.* 3*d.* in the £.

4. Find the simple interest on £670 15*s.* for 8 months at 5 per cent. per annum.

5. Add together $\frac{1}{3}$, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{3}{8}$.

6. Subtract $2\frac{3}{4}$ from $10\frac{1}{8}$.

7. Multiply $7\frac{1}{2}$ by $1\frac{4}{15}$.

8. Divide $9\frac{1}{4}$ by $2\frac{3}{17}$.

9. Add together 6·7248, ·003079, 46·24, 7·010709, and 10·643.

10. Subtract 93·608 from 141·72.

11. Multiply 63·174 by 4·06045.

12. Divide 46·732 by ·007.

13. Express 6·105 pounds Troy in grains.

14. Reduce 17 acres 14 perches to square yards, feet, and inches.

15. If a 4 lb. loaf cost 6*d.* when wheat is 50*s.* a quarter, what ought a sixpenny loaf to weigh when wheat is 66*s.* 8*d.* a quarter?

16. Find (by Practice) the cost of 2 qrs. 1 bushel 1 peck of oats at 4*s.* 4*d.* a bushel.

17. Find the amount of £1485 in 3 years at 4 per cent. compound interest (neglecting fractions of a penny).

18. Add together $\frac{2}{3}$, $1\frac{1}{2}$, $\frac{7}{24}$, and $1\frac{3}{8}$.

19. Subtract $\frac{4}{9}$ from $2\frac{1}{13}$.

20. Multiply $4\frac{1}{8}$, $\frac{2}{11}$, $\frac{8}{27}$, and $2\frac{1}{4}$.

21. Divide $3\frac{4}{13}$ by $7\frac{1}{6}$.

22. Add together 7·04087, 93·206, ·00535, 7·046, and 838·407.

23. Subtract 471·3207 from 500·6203.

24. Multiply 80·8054 by ·425.

25. Divide 73·611 by 743·1 to four places of decimals.

26. Find the value of 4·625 of 13*s.* 4*d.*

27. In 176325681 cubic inches, how many cubic yards, feet, and inches?

28. If 15 men can build a wall 7 feet long and 15 feet high in 16 days, in how many days will 10 men build a wall 35 feet long and 2 feet high?

29. Find (by Practice) the cost of three silver candlesticks, each weighing 4 oz. 7 dwts., at 7*s.* 6*d.* per ounce.

30. In what time will £2700 amount to £3219 15*s.* at $2\frac{3}{4}$ per cent. simple interest?

31. Add together $\frac{3}{4}$ of $\frac{5}{6}$, $\frac{4}{5}$ of $\frac{7}{8}$, and $\frac{1}{3}$ of $\frac{3}{5}$.

32. Subtract $69\frac{1}{8}$ from $72\frac{1}{3}$.

33. Multiply together $\frac{2}{3}$ of $\frac{4}{7}$, $\frac{5}{6}$ of $\frac{7}{8}$, and $\frac{3}{5}$ of $\frac{5}{6}$.

34. Divide $20\frac{1}{4}$ by $2\frac{1}{4}$.

35. Add together 471·0603, 12·07043, ·7131, ·002083, and 16·97.

36. Subtract 17·897 from 20·103.

37. Multiply 863·2 by ·00763.

38. Divide 63·611 by 737·405 to four places of decimals.

39. Reduce 630 seconds to the decimal of a week.

LX.

1. In 23568 grains how many lbs., oz., dwts., &c.?

2. If 137 lbs. of tallow cost £2 11*s.* $4\frac{1}{2}$*d.*, what is the price per ton?

3. Find (by Practice) the value of 2 cwt. 1 qr. 21 lbs. of zinc at £20 per ton.

4. Find the simple interest on £2570 for $5\frac{1}{2}$ years at 6 per cent. per annum.

5. Add together $\frac{5}{16}$, $3\frac{1}{4}$, $\frac{2}{3}$, and $\frac{11}{15}$.

6. Subtract $6\frac{2}{7}$ from $8\frac{1}{2}$.

7. Multiply $3\frac{3}{17}$ by $3\frac{7}{9}$.

8. Divide $3\frac{1}{9}$ by $5\frac{5}{6}$.

9. Add together 260·1307, ·82001, 46·24, 602·457, and 1·00059.

10. Subtract 37·2168 from 100·13201.

11. Multiply 26·207 by 3·1002.

12. Divide 3·764 by 28·213 to four places of decimals.

13. Express 2·465 of a ton in ounces.

14. Reduce 2 acres 2 roods 1 perch 3 yards to square inches.

15. If a bankrupt's debts amount to £7320 15*s.*, and his assets to £1220 2*s.* 6*d.*, what will a creditor receive on a bill of £327 6*s.* 3*d.*?

16. Find (by Practice) the dividend on £2741 10*s.* at 2*s.* $5\frac{1}{2}$*d.* in the £.

17. Find the amount of £4850 in 3 years at 4 per cent. compound interest (neglecting fractions of a penny).

18. Add together $3\frac{1}{2}$, $2\frac{5}{7}$, $\frac{3}{4}$, and $\frac{9}{14}$.

19. Subtract $8\frac{2}{5}$ from $10\frac{7}{11}$.

20. Multiply together $\frac{4}{5}$, $4\frac{3}{8}$, $1\frac{2}{7}$, and $1\frac{1}{3}$.

21. Divide $4\frac{1}{12}$ by $18\frac{2}{3}$.

22. Add together 50·00721, ·86541, 2·346, 800·25, ·00764, and 73·60789.

23. Subtract 32·156 from 209·00721.

24. Multiply ·007302 by ·6025.

25. Divide ·532 by 323 to four places of decimals.

26. Find the value of ·175 of £1 12*s.* 6*d.* in pence.

27. Reduce 3 tons 2 cwt. 2 qrs. 7 lbs. to ounces.

28. If 7 men mow a field of corn containing 37 acres in 3 days, working 8 hours a day, how many men must be employed to mow a field twice the size in 7 days, working 4 hours longer each day?

29. Find (by Practice) the cost of 120736812 articles at £1 3*s.* 6*d.* per dozen.

30. In what time will £1650 amount to £1891 6*s.* 3*d.* at $4\frac{1}{2}$ per cent. simple interest?

31. Add together $\frac{2}{3}$ of $\frac{4}{5}$, $\frac{1}{4}$ of $\frac{14}{15}$, and $\frac{4}{9}$ of $\frac{3}{8}$.

32. Subtract $6\frac{3}{4}$ from $17\frac{1}{10}$.

33. Multiply together $2\frac{2}{7}$ of $1\frac{4}{11}$, $2\frac{5}{8}$ of $\frac{4}{9}$, and $4\frac{2}{3}$ of $\frac{3}{4}$.

34. Divide $7\frac{1}{8}$ by $1\frac{7}{12}$.

35. Add together 267·3261, 12·07043, ·7131, ·002083, 754·507, and 7·00861.

36. Subtract 73·2861 from 80·1207.

37. Multiply 3750 by ·0263.

38. Divide 3·213531 by 45·261.

39. Reduce 32·16 pennyweights to the decimal of a pound Troy.

LXI.

1. In 758372 grains Troy how many pounds, &c.?

2. If 3 tons of copper cost £210, what will be the cost of $1\frac{1}{2}$ lbs.?

3. Find (by Practice) the value of 7 cwt. 3 qrs. 8 lbs. of cheese at £65 6*s.* 8*d.* per ton.

4. Find the simple interest on £7455 for 3 months at $2\frac{1}{2}$ per cent. per annum.

5. Add together $\frac{11}{12}$, $\frac{7}{8}$, and $4\frac{1}{2}$.

6. Subtract $7\frac{5}{11}$ from $11\frac{5}{7}$.

7. Multiply $9\frac{6}{31}$ by $2\frac{87}{89}$.

8. Divide $7\frac{3}{19}$ by $\frac{4}{38}$.

9. Add together 421·5, ·00763, 21·4285, 7·9, and 72·4599.

10. Subtract 50·9543 from 51·245685.

11. Multiply 110·543 by 2000.

12. Divide 3·1133256 by 741·2 to four places of decimals.

13. Express 1·9375 of a bushel in gallons and the decimal fraction of a gallon.

14. Reduce 8868097 cubic inches to cubic yards, feet, and inches.

15. 150 men had to do a piece of work in 65 days: 20 of the men falling ill, how long did the remaining number take to complete it?

16. Find (by Practice) the dividend on £10002 at 9*s.* $4\frac{1}{2}$*d.* in the pound.

17. Find the amount of £7205 in 2 years at $2\frac{5}{8}$ per cent. compound interest (neglecting fractions of a penny).

18. Add together $\frac{7}{11}$, $\frac{9}{13}$, $\frac{1}{2}$, and $\frac{15}{26}$.

19. Subtract $5\frac{11}{17}$ from $17\frac{4}{9}$.

20. Multiply together $1\frac{5}{9}$, $\frac{5}{6}$, and $15\frac{3}{7}$.

21. Divide $13\frac{7}{16}$ by $\frac{15}{96}$.

22. Add together 15·41215, ·00215, 416·5, 7211·0215, and 1000.

23. Subtract 471·2 from 1000·575.

24. Multiply 47·215785 by ·00218.

25. Divide ·03344318 by ·00425 to four places of decimals.

26. Find the value of 1·025 of 40 guineas in sixpences.

27. Reduce 150 tons 75 lbs. to ounces.

***28.** If the 4*d.* loaf weighs 10 ounces when wheat is 63*s.* a quarter, what would be the weight of the 2*d.* loaf when wheat is 54*s.* a quarter?

29. Find (by Practice) the cost of 945126 articles at £1 13*s.* 4*d.* per score.

30. At what rate per cent. simple interest will £2416 amount to £3050 4*s.* in 5 years?

31. Add together $\frac{3}{5}$ of $\frac{10}{11}$ and $5\frac{1}{2}$ of $\frac{2}{11}$.

32. Subtract $51\frac{7}{11}$ from $100\frac{1}{2}$.

33. Multiply together $\frac{2}{7}$ of $12\frac{3}{5}$ and $\frac{1}{9}$ of $1\frac{1}{2}$.

34. Divide $7\frac{4}{19}$ by $9\frac{1}{2}$.

35. Add together 154·2125, ·5421, ·0001215, 741·206, 14·4125, and 180000.

36. Subtract 512·416 from 1001·2.

37. Multiply 412·561 by 1·2045.

38. Divide 598·1482 by 412·5 to four places of decimals.

39. Reduce 75·0125 cwt. to pounds and the decimal fraction of a pound.

LXII.

1. In 758372 ounces how many tons, cwt., &c.

2. If 3 yards of silk cost 13*s.* $10\frac{1}{2}$*d.*, what will 177 yards cost?

3. Find (by Practice) the value of 72 cwt. 3 qrs. 7 lbs. of sugar at 24*s.* per cwt.

4. Find the simple interest on £8245 for 4 months at 3 per cent. per annum.

5. Add together $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, and $\frac{3}{8}$.

6. Subtract $2\frac{1}{4}$ from $20\frac{1}{8}$.

7. Multiply $\frac{4}{11}$ by $1\frac{4}{7}$.

8. Divide $2\frac{3}{4}$ by $\frac{11}{16}$.

9. Add together 4·7638, ·006203, 7, 19·634, and 32·62.

10. Subtract 7·6437 from 8·06437.

11. Multiply 5·736 by ·0203.

12. Divide 4·67 by 22·643 to four places of decimals.

13. Express 1·9375 of an ounce as a decimal fraction of a pound Troy.

14. Reduce 8868097 square feet to acres, roods, perches, and yards.

15. If 10 men can build a wall 65 feet long and 5 feet high in $3\frac{1}{4}$ days, in how many days will 6 men build a wall 80 feet long and 4 feet high?

16. Find (by Practice) the dividend on £8236 10*s.* at 4*s.* 7*d.* in the £.

17. Find the amount of £7205 in three years at 6 per cent. compound interest (neglecting fractions of a penny).

18. Add together $\frac{1}{9}$, $\frac{1}{15}$, $\frac{1}{18}$, and $4\frac{1}{6}$.

19. Subtract $1\frac{1}{9}$ from $3\frac{1}{18}$.

20. Multiply together $\frac{2}{3}$, $\frac{5}{7}$, $1\frac{3}{4}$, and $\frac{1}{8}$.

21. Divide $10\frac{1}{8}$ by $1\frac{11}{16}$.

22. Add together 16·41215, 9·376, ·00403, 177·42, and 27·03067.

23. Subtract 17·2398 from 27·06.

24. Multiply 46·2375 by ·00743.

25. Divide 92·3784 by ·623 to four places of decimals.

26. Find the value of 1·025 of £1 13*s.* 4*d.*

27. Reduce 973376 grains to lbs., oz., &c. (Troy weight).

28. If the 4*d.* loaf weighs 14 oz. when wheat is 63*s.* a quarter, what would be the weight of the 2*d.* loaf when wheat is 84*s.* a quarter?

29. Find (by Practice) the rent of 125 acres 1 rood 7 perches of land at £1 13*s.* 4*d.* per rood.

30. In what time will £2175 amount to £2338 2*s.* 6*d.* at $2\frac{1}{2}$ per cent. (simple interest)?

31. Add together $2\frac{1}{6}$, $\frac{1}{12}$, $3\frac{1}{16}$, and $\frac{5}{8}$.

32. Subtract $9\frac{1}{11}$ from $10\frac{1}{22}$.

33. Multiply together $\frac{3}{8}$, $\frac{4}{7}$, $4\frac{9}{10}$, $\frac{5}{6}$, and $1\frac{2}{3}$.

34. Divide $1\frac{1}{4}$ by $6\frac{1}{4}$.

35. Add together 6·72358, ·076407, 23·742, and 973·25.

36. Subtract 100·69 from 1000·035.

37. Multiply ·04768 by 42·63.

38. Divide ·432 by ·073 to four places of decimals.

39. Reduce 20736 cubic inches to cubic yards, and the decimal fraction of a cubic yard.

LXIII.

1. Reduce 12 tons 3 qrs. 17 lbs. 4 oz. to ounces.

2. The price of silver being 5*s.* 6*d.* per ounce, what will be the value of 8 oz. 6 dwts. 16 grains?

3. Find (by Practice) the value of 13840 articles at 16*s.* 9*d.* a score.

4. Find the simple interest on £656 6*s.* 8*d.* for $2\frac{1}{2}$ months at $7\frac{1}{2}$ per cent. per annum (neglecting fractions of a penny).

5. Add together $\frac{3}{8}$, $12\frac{1}{5}$, $1\frac{2}{9}$, and $2\frac{7}{12}$.

6. Subtract $8\frac{1}{4}$ from $13\frac{2}{11}$.

7. Multiply $3\frac{3}{7}$ by $\frac{35}{48}$.

8. Divide $\frac{1}{16}$ by $1\frac{5}{8}$.

9. Add together 993, 2·0624, ·00441, and 23·7421.

10. Subtract 500·2107328 from 623·51414.

11. Multiply 243·19 by ·0177.

12. Divide 47·341 by 329·7 to three places of decimals.

13. Reduce ·0253 of a mile to feet and the decimal of a foot.

14. In 6055 grains how many lbs., oz., dwts., &c., are there?

15. A sack of potatoes weighs 178 lbs., and if 6 such sacks cost £2 4*s.* 6*d.*, what will be the cost of 44 lbs.?

16. Find (by Practice) the price of 3 pecks 1 gallon 3 quarts 1 pint at £4 12*s.* per gallon.

17. Find the amount of £1500 for 3 years at $6\frac{1}{2}$ per cent. compound interest (neglecting fractions of a penny).

18. Add together $5\frac{1}{4}$, $\frac{13}{20}$, $2\frac{4}{9}$, and $\frac{13}{36}$.

19. Subtract $12\frac{6}{35}$ from $17\frac{2}{13}$.

20. Multiply $\frac{10}{43}$ by $11\frac{7}{15}$.

21. Divide $1\frac{35}{64}$ by $\frac{5}{32}$.

22. Add together 57·14, 3842·29731, ·000246, and 467.

23. Subtract 37·8467219 from 52·412.

24. Multiply 6·5862 by 740.

25. Divide 3·48223 by ·0047.

26. Express 42 lbs. as a decimal of a ton.

27. In 273856033 square inches how many acres, roods, perches, &c.?

28. The rates of a railway train and a coach are as 7 to 2; the former can travel 42 miles an hour; how long will it take the latter to go 342 miles?

29. Find (by Practice) the price of 2 qrs. 14 lbs. at £5 16*s*. 8*d*. a ton.

30. At what rate per cent. simple interest will £1250 amount to £1962 10*s*. in 6 years?

31. Add together $7\frac{1}{3}$, $\frac{5}{9}$, $\frac{14}{24}$, and $9\frac{11}{12}$.

32. Subtract $20\frac{3}{11}$ from $31\frac{9}{35}$.

33. Multiply together $7\frac{3}{5}$, $\frac{7}{11}$, $\frac{8}{19}$, and 12.

34. Divide $9\frac{1}{3}$ by 7.

35. Add together ·001234, 1003·5687, 1012·9763, and 99.

36. Subtract 99·0013 from 100.

37. Multiply ·001357 by 1·00661.

38. Divide 99·765301 by 1·00134 to four places of decimals.

39. Give the value of 5·298 of 6*s*. 8*d*. in pence, and the decimal fraction of a penny.

LXIV.

1. Reduce 5 tons 3 qrs. 17 lbs. 13 oz. to ounces.

2. How much must be given for 29 articles at £3 16*s*. 6*d*. a dozen?

3. Find (by Practice) the value of 7128 articles at £4 5*s*. $10\frac{3}{4}$*d*. a piece.

4. Find the simple interest on £348 10*s*. for 7 years at $4\frac{1}{2}$ per cent. per annum.

5. Add together $3\frac{2}{5}$, $\frac{4}{9}$, $1\frac{5}{12}$, and $\frac{7}{10}$.

6. Subtract $5\frac{7}{8}$ from $8\frac{3}{5}$.

7. Multiply $14\frac{1}{9}$ by $10\frac{1}{8}$.

8. Divide $17\frac{5}{8}$ by $19\frac{2}{5}$.

9. Add together 381·105, 4·692, ·0001, and 54·0096.

10. Subtract 392·68154 from 400·0612.

11. Multiply 129·342 by 5·26.

12. Divide 79·105 by 12·086 to four places of decimals.

13. Reduce ·334375 of a pound to shillings and pence.

14. In 32478621 inches how many miles, furlongs, yards, &c.?

15. If when wheat is 60*s*. a quarter the 6*d*. loaf weighs 4 lbs., what should be paid for 25 lbs. when wheat is 40*s*. a quarter?

16. Find (by Practice) the price of 3 lbs. 5 oz. 14 dwts. 12 grains at 17*s*. 6*d*. per ounce.

17. Find the amount of £412 10*s*. for 3 years at 6 per cent. compound interest (neglecting fractions of a penny).

18. Add together $\frac{13}{14}$, $1\frac{17}{18}$, $\frac{3}{4}$, and $2\frac{11}{12}$.
19. Subtract $10\frac{11}{13}$ from $16\frac{5}{91}$.
20. Multiply $4\frac{2}{3}$ by $\frac{3}{7}$.
21. Divide $10\frac{8}{9}$ by $\frac{42}{53}$.
22. Add together 39·0016, 4215·05, ·07364, and 1·009.
23. Subtract 38·09652 from 100.
24. Multiply 30·561 by ·0016.
25. Divide ·030734 by 20·56 to four places of decimals.
26. Reduce 121121 inches to the decimal of a mile.
27. Reduce 10 acres 3 poles $10\frac{1}{4}$ square yards to square inches.

28. If 7 men working 16 days can mow a field of corn 1320 yards long and 880 wide, what will be the length of the side of a field 1320 yards broad which 4 men can mow in 42 days?

29. Find (by Practice) the cost of a telegram consisting of 425 words at £1 12*s*. 6*d*. per twenty words.

30. In what time will £225 amount to £256 10*s*. at 4 per cent. simple interest?

31. Add together $3\frac{1}{7}$, $10\frac{13}{112}$, $\frac{15}{28}$, and $1\frac{1}{4}$.
32. Subtract $\frac{14}{15}$ from $2\frac{1}{4}$.
33. Multiply together $\frac{2}{9}$, $\frac{14}{15}$, $1\frac{5}{28}$, and $\frac{81}{82}$.
34. Divide $3\frac{2}{3}$ by $4\frac{1}{9}$.
35. Add together 374·826, ·19241, ·09059, and ·0006.
36. Subtract 426·5793 from 510·81.
37. Multiply ·10065 by 428.
38. Divide ·00329875 by ·0754.
39. Reduce $10\frac{3}{4}$*d*. to the decimal of 1*s*. 6*d*.

LXV.

1. In 372483 ounces how many tons, cwt., qrs., &c.?

2. If cotton is shipped at four guineas a cwt., what is the weight of a bale costing £21 9*s*.?

3. Find (by Practice) the value of 27 lbs. 6 oz. 6 dwts. of gold dust at £3 10*s*. 5*d*. an ounce.

4. Find the simple interest on £6250 for 18 years at $2\frac{1}{2}$ per cent. per annum.

5. Add together $5\frac{3}{7}$, $\frac{14}{15}$, $\frac{19}{42}$, and $3\frac{1}{3}$.

6. Subtract $9\frac{3}{13}$ from $10\frac{1}{143}$.
7. Multiply $6\frac{3}{10}$ by $\frac{25}{27}$.
8. Divide $31\frac{7}{9}$ by $1\frac{62}{81}$.
9. Add together 371·87001, ·0031, ·00631, and 5786·44321.
10. Subtract 185·939131 from 186·847.
11. Multiply 323·211 by ·20343.
12. Divide 343·5777 by ·525 to three places of decimals.
13. What fraction of a sovereign is ·345 of £1 4*s.*?
14. Reduce 3 quarters 7 bushels 1 gallon to pints.
15. The market price of wheat being £3 4*s.* per quarter, what will be the value of 11 bushels and 3 pecks?
16. Find (by Practice) the dividend on £3760 15*s.* at 17*s.* 9*d.* in the £.
17. Find the amount of £4096 in 3 years at $1\frac{1}{4}$ per cent. compound interest (neglecting fractions of a penny).
18. Add together $5\frac{11}{18}$, $\frac{7}{8}$, $3\frac{4}{27}$, and $1\frac{1}{16}$.
19. Subtract $\frac{8}{17}$ from $\frac{7}{13}$.
20. Multiply together $5\frac{6}{17}$, $\frac{85}{144}$, $\frac{36}{49}$, and $1\frac{1}{13}$.
21. Divide $\frac{17}{96}$ by $6\frac{3}{8}$.
22. Add together 11·431, ·00101, 243·734, 400, and 1·3743.
23. Subtract 876·315 from 1000.01.
24. Multiply 7·3406 by ·00437.
25. Divide ·003634 by ·0632.
26. Find the value of ·0625 of an acre.
27. Reduce 1 mile 7 furlongs 5 perches $2\frac{1}{2}$ yards to inches.
28. If 49 men can empty a reservoir in 65 days, pumping 8 hours a day, how many hours a day must 196 men pump to empty it in 26 days?
29. Find (by Practice) the value of 7719 articles at £1 7*s.* 6*d.* per dozen.
30. At what rate per cent. will £461 10*s.* amount to £611 9*s.* 9*d.* in 13 years at simple interest?
31. Add together $\frac{4}{9}$, $\frac{7}{13}$, $1\frac{35}{36}$, and $\frac{15}{91}$.
32. Subtract $12\frac{3}{11}$ from $15\frac{2}{33}$.
33. Multiply together $\frac{7}{18}$, $3\frac{1}{12}$, $1\frac{7}{11}$, and $\frac{3}{74}$.
34. Divide $5\frac{2}{7}$ by $\frac{74}{343}$.
35. Add together 1·001 of a cwt. and ·039 of a quarter, and give the answer in ounces and the decimal fraction of an ounce.

36. Subtract ·335 of a gallon from 12·51 of a quart, and give the answer in pints and the decimal of a pint.

37. Multiply ·003631 by 200·01.

38. Divide 28·028 by 4900.

39. Reduce 13*s.* 6*d.* to the decimal of £3.

LXVI.

1. Reduce 5 acres 3 roods 4 perches 4 yards to square inches.

2. If 19 gallons of whiskey cost £7 16*s.* 9*d.*, what is the price of 37 gallons?

3. Find (by Practice) the value of $675\frac{1}{2}$ yards at £2 14*s.* 4*d.* per yard.

4. Find the simple interest on £774 11*s.* 3*d.* for 4 years at 5 per cent. per annum.

5. Add together $3\frac{3}{8}$, $1\frac{5}{6}$, $\frac{11}{12}$, and $1\frac{5}{24}$.

6. Subtract $\frac{1}{3}$ from $1\frac{21}{32}$.

7. Multiply $\frac{36}{55}$ by $\frac{22}{23}$.

8. Divide $\frac{2}{3}$ by $3\frac{3}{11}$.

9. Add together 394·8427, ·05862, 8·77, and 15·871.

10. Subtract 995·612 from 1100·801.

11. Multiply 478·5 by ·00681.

12. Divide 80·13 by 12·065 to five places of decimals.

13. Express 1·015 of a pound Troy in grains.

14. In 693487 grains Troy how many pounds, ounces, pennyweights, &c.?

15. If 172 cwt. 2 qrs. 18 lbs. of rye cost £87 6*s.* 3*d.*, how much may be bought at the same rate for £3 19*s.* $4\frac{1}{2}$*d.*?

16. Find (by Practice) the dividend on £457 13*s.* 4*d.* at 17*s.* 6*d.* in the pound.

17. Find the amount of £8075 in 3 years at $2\frac{1}{2}$ per cent. compound interest (neglecting fractions of a penny).

18. Add together $2\frac{7}{8}$, $\frac{1}{12}$, $\frac{17}{18}$, and $1\frac{23}{24}$.

19. Subtract $\frac{5}{8}$ from $1\frac{1}{6}$.

20. Multiply together $\frac{3}{4}$, $\frac{8}{9}$, $3\frac{1}{3}$, and 27.

21. Divide $8\frac{1}{8}$ by $7\frac{7}{9}$.

22. Add together 906·3815, 87·637, 50·732, and 89·60985.

23. Subtract 89·927 from 91.

24. Multiply 375·61 by 68·02.

25. Divide 38·5866 by 66·3.

26. Express £·01685 in farthings.

27. Reduce 3 miles 1 furlong 14 poles 5 yards to feet.

28. If 12 horses plough 11 acres in 5 days, how many horses would plough 33 acres in 18 days?

29. Find (by Practice) the value of 319 cwt. 3 qrs. 16 lbs. at £2 12*s.* 6*d.* per cwt.

30. In what time will £4500 amount to £5141 5*s.* at 3 per cent. per annum simple interest?

31. Add together $\frac{23}{25}$, $3\frac{2}{5}$, $\frac{7}{24}$, and $\frac{11}{15}$.

32. Subtract $4\frac{7}{10}$ from $5\frac{3}{10}$.

33. Multiply together $19\frac{1}{8}$, $1\frac{15}{17}$, $\frac{1}{12}$, and $\frac{1}{3}$.

34. Divide 18 by $5\frac{1}{7}$.

35. Add together 4·018 of a day and ·0965 of an hour, and give the answer in minutes and the decimal fraction of a minute.

36. Subtract ·986 of a pint from 1·032 of a bushel.

37. Multiply ·0685 by ·0015.

38. Divide ·0132606 by ·000417.

39. Reduce ·48 of a penny to the decimal of £1.

LXVII.

1. Reduce 2 lbs. 3 oz. 4 dwts. to grains.

2. If £2 1*s.* 8*d.* will buy 2 tons 3 cwt. of coals, how much may be bought for £100?

3. Find (by Practice) the value of 12 tons 3 cwt. 2 qrs. 14 lbs. at £3 per ton.

4. Find the simple interest on £5453 for 9 years at $5\frac{1}{4}$ per cent. per annum, neglecting fractions of a penny.

5. Add together $3\frac{2}{9}$, $4\frac{5}{8}$, $\frac{15}{16}$, and $\frac{13}{20}$.

6. Subtract $14\frac{15}{17}$ from $25\frac{3}{20}$.

7. Multiply $2\frac{3}{16}$ by $\frac{8}{35}$.

8. Divide $25\frac{11}{12}$ by $4\frac{23}{72}$.

9. Add together 7·0031, ·00631, 786·443210, and 439·68731.

10. Subtract 187·84756 from 200·0732.

11. Multiply 526·399 by ·0273.

12. Divide 1·806 by 6·45.

13. Reduce 2 yards 2 feet 3 inches to the decimal of a mile.

14. Reduce 3 miles 2 furlongs 5 poles 2 yards to feet.

15. If I get 1 lb. of bread for 1*s.* when wheat is 6*s.* a bushel, what should be the price of wheat per quarter when I get 12 oz. of bread for 4*d.*?

16. Find (by Practice) the dividend on £327 16*s.* 8*d.* at 13*s.* 3*d.* in the £.

17. Find the amount of £2880 in 3 years at $3\frac{1}{2}$ per cent. compound interest (neglecting fractions of a penny).

18. Add together $6\frac{2}{11}$, 5, $4\frac{13}{25}$, and $\frac{11}{20}$.

19. Subtract $8\frac{8}{15}$ from $12\frac{3}{28}$.

20. Multiply together $1\frac{2}{5}$, $5\frac{1}{3}$, $\frac{1}{4}$, and $\frac{15}{28}$.

21. Divide 11 by $4\frac{5}{23}$.

22. Add together 11·431, 243·734, 400, ·0005, and 54·4455.

23. Subtract 489·938 from 501·2635.

24. Multiply ·6840 by ·0985.

25. Divide 12·987 by 2220.

26. Reduce ·02753 of one guinea to pence and the decimal of a penny.

27. In 562493 ounces how many tons, cwt., qrs., &c.?

28. A bankrupt's debts amount to £16000, and his assets to £7000, what will a creditor receive to whom he owes £427 5*s.*?

29. Find (by Practice) the value of 57625 articles at £1 11*s.* 7*d.* per score.

30. At what rate per cent. will £345 amount to £515 15*s.* 6*d.* in 11 years at simple interest?

31. Add together $4\frac{17}{30}$, $\frac{13}{27}$, $\frac{5}{18}$, and $2\frac{7}{10}$.

32. Subtract $12\frac{33}{40}$ from $20\frac{5}{24}$.

33. Multiply together $6\frac{4}{11}$, $\frac{5}{9}$, $\frac{11}{20}$, and $\frac{3}{7}$.

34. Divide $\frac{93}{155}$ by 15.

35. Add together 62·309, 543·2576, ·00654, and 2·92549.

36. Subtract 599·9876 from 1000·2087.

37. Multiply ·02689 by ·005432.

38. Divide 77·88 by ·00885.

39. Reduce ·263 of 2 lbs. 3 oz. 6 dwts. to grains and the decimal of a grain.

LXVIII.

1. In 234563 grains Troy how many lbs., oz., &c., are there?

2. If 21 cwt. of sugar cost £96 12*s.*, what is the price of 70 lbs.?

3. Find (by Practice) the dividend on £418 16*s.* at 5*s.* 10*d.* in the £.

4. Find the simple interest on £1715 1*s.* 8*d.* for 5 years at 3 per cent. per annum.

5. Add together $\frac{15}{19}$, $1\frac{1}{2}$, $6\frac{7}{114}$, and $\frac{13}{57}$.

6. From $15\frac{1}{9}$ take $14\frac{3}{8}$.

7. Multiply $\frac{14}{15}$ by $2\frac{1}{22}$.

8. Divide $\frac{8}{17}$ by $\frac{11}{51}$.

9. Add together 34·9362, ·00063, 43·2875, and 5432·92543.

10. Subtract 69·74352 from 101·207359.

11. Multiply 763·15 by ·0129.

12. Divide 765·123 by 12·56 to three places of decimals.

13. Reduce 13*s.* $6\frac{3}{4}$*d.* to the decimal of £4.

14. Reduce 3 quarters 2 bushels 1 peck 3 quarts to pints.

15. If a 4*d.* loaf weighs 2 lbs. when wheat is 60*s.* a quarter, what will be the price of 30 lbs. of bread when wheat is 40*s.* a quarter?

16. Find (by Practice) the cost of 12 cwt. 3 qrs. $3\frac{1}{2}$ lbs. at 48*s.* a cwt.

17. Find the compound interest on £3695 in 3 years at $4\frac{1}{2}$ per cent. per annum (neglecting fractions of a penny).

18. Add together $2\frac{3}{4}$, $\frac{9}{16}$, $3\frac{5}{12}$, and $\frac{17}{24}$.

19. From $1\frac{1}{12}$ take $\frac{18}{25}$.

20. Multiply $4\frac{2}{3}$, $\frac{3}{4}$, $1\frac{1}{14}$, and $1\frac{1}{2}$.

21. Divide $22\frac{1}{7}$ by $16\frac{6}{19}$.

22. Add together 3·50621, ·00403, 177·42, 26·325, and 5·0735.

23. Subtract 38·5601 from 40·002.

24. Multiply 34·065 by 10·0063.

25. Divide 56·277 by ·507.

26. Reduce ·0465 of a mile to yards.

27. Reduce 40 acres 3 roods 16 poles to square feet.

28. If 12 men can build a wall 6 feet high and 3 feet thick in 9 days, how many men would build one 5 feet high and feet thick in 24 days?

29. Find (by Practice) the value of 90072 articles at £2 17*s.* 6*d.* a dozen.

30. In what time will £3745 amount to £3932 5*s.* at $2\frac{1}{2}$ per cent. per annum simple interest?

31. Add together $3\frac{7}{11}$, $\frac{11}{12}$, $4\frac{2}{9}$, and $\frac{13}{66}$.

32. From $\frac{13}{18}$ take $\frac{29}{48}$.

33. Multiply $10\frac{1}{2}$, $2\frac{5}{6}$, $\frac{4}{21}$, and $3\frac{3}{20}$.

34. Divide $\frac{8}{33}$ by $9\frac{4}{11}$.

35. Add together 2·453 of a day and ·055 of an hour, and give the answer in minutes and the decimal fraction of a minute.

36. Subtract ·036 of a mile from 6 furlongs, and give the answer in yards and the decimal fraction of a yard.

37. Multiply ·006392 by ·0015.

38. Divide ·01404 by ·195.

39. Express ·015 of a cubic yard in cubic inches and the decimal fraction of a cubic inch.

LXIX.

1. In 5005001 ounces how many tons, cwt., &c.?

2. If 20 sheep cost £37 12*s.* 6*d.*, what will 311 cost?

3. Find (by Practice) the dividend on £334 10*s.* at 13*s.* 5*d.* in the pound.

4. Find the simple interest on £2333 15*s.* for 3 years at $1\frac{1}{2}$ per cent. per annum.

5. Add together $\frac{11}{12}$, $\frac{3}{4}$, 10, and $\frac{1}{3}$.

6. Subtract $1\frac{7}{8}$ from $4\frac{2}{3}$.

7. Multiply $\frac{14}{17}$ by $2\frac{13}{19}$.

8. Divide $66\frac{2}{3}$ by $3\frac{5}{6}$.

9. Add together 3000·3, 52003·052, ·9, and ·08.

10. Subtract 3·60124 from 30·5001.

11. Multiply 20·406 by 361·03.

12. Divide 19·854 by ·1125.

13. Reduce $\frac{3}{4}$ of 12*s.* to the decimal of £2.

14. In 51130003 inches how many miles, &c.?

15. What income corresponds to an income-tax of £13 5*s.* 10*d.* at 10*d.* in the pound.

16. Find (by Practice) the rent of 5 acres 3 roods 12 poles at 40*s.* an acre.

17. Find the amount of £1050 in 4 years at 4 per cent. per annum, compound interest (neglecting fractions of a penny).

18. Add together $\frac{7}{5}$, $\frac{113}{55}$, and $\frac{17}{550}$.

19. Subtract $\frac{131}{153}$ from $11\frac{15}{17}$.

20. Multiply $2\frac{4}{15}$ by $1\frac{5}{14}$.

21. Divide $\frac{15}{68}$ by $4\frac{13}{153}$.

22. Add together 5·013, ·704, 8·5639205, ·5201, and ·0095001.

23. From 44·020002 take ·3300063.

24. Multiply 8304 by ·0976.

25. Divide 4·4535 by ·0245 to three places of decimals.

26. Find the value of 4·2125 of 20 lbs. Avoirdupois.

27. Reduce 3440707 seconds to weeks, days, &c.

28. If the 6*d.* loaf weighs $3\frac{1}{4}$ lbs. when wheat is at 50*s.* a bushel, what ought it to weigh when wheat is at 40*s.* a bushel?

29. Find (by Practice) the value of 3 qrs. 1 bushel 1 gallon at £2 13*s.* 4*d.* per quarter.

30. In what time will £4550 amount to £13195 at $3\frac{3}{4}$ per cent. per annum, simple interest?

31. Add together 46, $3\frac{7}{15}$, $\frac{181}{25}$, and $\frac{2}{3}$.

32. From $15\frac{1}{24}$ take $\frac{19}{16}$.

33. Multiply $\frac{114}{7}$, $1\frac{6}{57}$, and $\frac{34}{57}$.

34. Divide $25\frac{7}{8}$ by $\frac{46}{16}$.

35. Add together ·336202, ·174, 70·539501, 6678·5, and ·83507.

36. From ·1 take ·0440509.

37. Multiply 343261 by ·0312.

38. Divide ·04963 by ·225.

39. Reduce a pint and a half to the decimal of a gallon.

LXX.

1. In 2400520 grains Troy, how many lbs., oz., &c.?

2. If 5 tons of coal cost £6 5*s.*, what would $4\frac{1}{2}$ cwt. cost?

3. Find (by Practice) the price of 2 tons 4 cwt. 1 qr. 17 lbs. at £11 13*s.* 4*d.* per ton.

4. Find the simple interest on £1222 10*s.* for 8 years at $1\frac{1}{2}$ per cent. per annum.

5. Add together $\frac{9}{14}$, $\frac{1}{42}$, and $\frac{4}{21}$.

6. Subtract $\frac{8}{21}$ from $5\frac{17}{30}$.
7. Multiply $\frac{2}{15}$ by $5\frac{1}{12}$.
8. Divide $\frac{7}{25}$ by $4\frac{1}{100}$.
9. Add together 4073·30719, ·000093, 1034·5, ·4, and ·5.
10. Subtract 3·070101 from 41·00234.
11. Multiply 7840·6 by 2·0103.
12. Divide 1548·32 by 1·125.
13. Reduce $3\frac{3}{4}$ guineas to the decimal of £5 10*s*.
14. In 6422014 inches, how many miles, furlongs, &c.?
15. What is the income corresponding to an income-tax of £10 at 10*d.* in the £?
16. Find (by Practice) the price of 12 acres 2 roods 12 poles at £37 10*s*. per acre.
17. Find the amount of £205 in 3 years at $7\frac{1}{4}$ per cent. per annum compound interest (neglecting fractions of a penny).
18. Add together $\frac{5}{3}$, $\frac{5}{33}$, and $\frac{1}{330}$.
19. Subtract $\frac{443}{400}$ from $5\frac{17}{30}$.
20. Multiply $\frac{46}{250}$ by $\frac{1}{230}$.
21. Divide $7\frac{1}{7}$ by $\frac{25}{42}$.
22. Add together ·50145, 3077·5, 30·001, 8·00028, and ·000945.
23. Subtract ·44006 from 17·85.
24. Multiply ·17034 by 781.
25. Divide 24·032 by ·00245 to three places of decimals.
26. Find the value of 2·2128 lbs. Troy.
27. Reduce 4 cubic yards 12 cubic feet to cubic inches.
28. If 1 man working 12 hours a day does a piece of work in 18 days, how many hours a day must 6 men work to do the same in 9 days?
29. Find (by Practice) the price of 3 oz. 10 dwts. 15 grs. of gold at £3 10*s*. per oz.
30. In what time will £4550 amount to £6597 10*s*. at 6 per cent. per annum simple interest?
31. Add together $\frac{2}{25}$, $6\frac{3}{40}$, $3\frac{4}{5}$, and $\frac{11}{60}$.
32. Subtract $3\frac{13}{23}$ from $100\frac{3}{46}$.
33. Multiply $\frac{19}{28}$, $1\frac{11}{57}$, and $\frac{68}{81}$.
34. Divide $100\frac{1}{3}$ by $1\frac{1}{10}$.
35. Add together ·20134, ·01992, 5·0434, ·061, and 300·001.

36. Subtract ·00099901 from ·02009.
37. Multiply 6525 by ·002453.
38. Divide ·9917 by ·225.
39. Reduce a pint and a half to the decimal of 2 gallons.

LXXI.

1. In 13400520 ounces how many tons, cwt., &c.?

2. If 7 lbs. of tea cost 30*s.* 4*d.*, how much will 129 lbs. cost?

3. Find (by Practice) the dividend on £432 5*s.* at 17*s.* 8*d.* in the pound.

4. Find the simple interest on £101 5*s.* 6*d.* for 20 years at $2\frac{1}{2}$ per cent. per annum.

5. Add together $\frac{9}{11}$, $\frac{3}{4}$, and $\frac{1}{22}$.
6. Subtract $3\frac{13}{23}$ from $100\frac{3}{46}$.
7. Multiply $\frac{1}{15}$ by $4\frac{1}{12}$.
8. Divide $\frac{7}{50}$ by $1\frac{1}{100}$.
9. Add together ·407330719, ·000093, 1·0345, 475, and ·005301.
10. Subtract 37·0101 from 410·02.
11. Multiply 7840·6 by 54·05.
12. Divide 154832 by ·05625.
13. Reduce $\frac{5}{6}$ of 12*s.* 6*d.* to the decimal of £1.
14. In 6217010 inches how many miles, furlongs, &c.?
15. What income corresponds to an income tax of £45 at 4*d.* in the £?
16. What is the price of 37 acres 2 roods 15 poles at £40 10*s.* per acre?
17. Find the amount of £1000 in 4 years at 8 per cent. per annum compound interest.
18. Add together $\frac{23}{5}$, $\frac{7}{40}$, $\frac{1}{20}$, and $\frac{7}{80}$.
19. Subtract $\frac{443}{400}$ from $5\frac{1}{2}$.
20. Multiply $\frac{51}{220}$ by $\frac{10}{153}$.
21. Divide $51\frac{3}{4}$ by $\frac{23}{8}$.
22. Add together ·50145, 3077·5, 30·001, 80002, and ·000945.
23. Subtract ·055006 from 1·002.
24. Multiply ·017034 by 5340.
25. Divide 22·097 by 5263·2 to four places of decimals.

26. What decimal of £6 5*s.* is 3*s.* 6*d.*?

27. Reduce 4 cubic yards 12 cubic inches to cubic inches.

28. If the 6*d.* loaf weighs 4 lbs. when wheat is at 39*s.* a quarter, what ought it to weigh when wheat is at 52*s.* a quarter?

29. Find (by Practice) the price of 3 oz. 13 dwts. 18 grs. at £3 10*s.* per oz.

30. In what time will £4550 amount to £5573 15*s.* at 3 per cent. per annum, simple interest?

31. Add together $\frac{2}{7}$, $6\frac{2}{21}$, $1\frac{5}{14}$, and $\frac{11}{70}$.

32. Subtract $\frac{1}{3}$ from $2\frac{1}{6}$.

33. Multiply $1\frac{5}{14}$, $1\frac{6}{57}$, and $\frac{34}{51}$.

34. Divide $8\frac{1}{8}$ by $1\frac{5}{8}$.

35. Add together 20134·01992, 2·0028803, ·00001, and 30·00001.

36. Subtract ·00099901 from 4321.

37. Multiply ·6523 by ·002453.

38. Divide ·04009 by ·36.

39. How many pints are there in 20·125 gallons?

OUT-DOOR CUSTOMS.

(Two and a half hours.)

LXXII.

1. Reduce 4 tons 7 cwt. 1 qr. 13 lbs. 12 oz. to ounces.

2. If 13 lbs. of sugar cost 4*s.* $10\frac{1}{2}$*d.*, what will be the cost of 213 lbs.?

3. Find (by Practice) the cost of 63 cwt. of artificial manure at £5 12*s.* 6*d.* per ton.

4. Find the simple interest on £106 13*s.* 4*d.* for 15 months at $4\frac{1}{2}$ per cent. per annum.

5. Add together $3\frac{1}{8}$, $\frac{2}{3}$, $1\frac{4}{15}$, and $\frac{39}{40}$.

6. Subtract $5\frac{4}{9}$ from $6\frac{7}{12}$.

7. Multiply $12\frac{3}{8}$ by $1\frac{5}{11}$.

8. Divide $4\frac{2}{3}$ by $13\frac{1}{8}$.

9. Add together 84·006, ·002604, 845, and 70·0015603.

10. Subtract 73·4698 from 108·30125.

11. Multiply 302·468 by 400.

12. Divide 78 by 361·059 to four places of decimals.

13. Reduce 3·8375 of an acre to roods and perches.

14. In 164723 pints how many quarters, bushels, pecks, &c.?

15. If 15 men can reap 20 acres of corn in 6 days, working 14 hours a day, how many men must be employed to assist 10 other men to reap 6 acres in $1\frac{3}{4}$ days of 8 hours a day?

16. Find (by Practice) the dividend on £721 13*s.* 6*d.* at 14*s.* 2*d.* in the £.

17. Find the amount of £8900 in three years at $2\frac{1}{2}$ per cent. compound interest (neglecting fractions of a penny).

18. Add together $\frac{14}{17}$, $3\frac{1}{9}$, $1\frac{5}{51}$, and $\frac{6}{27}$.

19. Subtract $5\frac{4}{13}$ from $6\frac{1}{9}$.

20. Multiply together $4\frac{1}{8}$, $\frac{16}{21}$, $1\frac{3}{11}$, and $\frac{1}{2}$.

21. Divide $3\frac{7}{9}$ by $\frac{17}{63}$.

22. Add together 84·6912, ·001567, 1·0056, and 549·2.

23. Subtract 23·69428 from 50·012.

24. Multiply 40·061 by ·0054.

25. Divide ·055757592 by ·009207.

26. Reduce 33 yards to the decimal of a mile.

27. A person takes a railway return-ticket for a month, paying 25 per cent. more for it than he would have done for a single ticket. At the end of the month he obtains an extension of the time for a week by paying 5 per cent. on the monthly ticket. The whole sum paid is £2 12*s*. 6*d*. Find the price of the single ticket.

*28. Extract the cube root of 9555119848.

29. When the 3 per Cents are at $87\frac{1}{2}$, and shares paying 5 per cent. are at $130\frac{1}{4}$, which is the more profitable investment? and what sum does a person invest when the difference of the incomes resulting from the two investments is £561?

30. Reduce $\cdot 267\dot{1}87\dot{5}$ to a vulgar fraction, and if the unit be £6, reduce the fraction to shillings, pence, and decimals of a penny.

31. Find the prime factors of 111540, 42336, 67392; and thence write down the smallest number which they will all divide without remainder.

32. If the weight of one cubic foot of water is 62·35 pounds Avoirdupois, find the error in calculating the weight of 1000 cubic feet on the approximate assumption that one cubic foot weighs 1000 oz.

LXXIII.

1. Reduce 5 tons 10 cwt. 3 qrs. 14 lbs. 7 oz. to ounces.

2. The proportion of the diameter of a circle to its circumference is very nearly 113 to 355; find the circumference of a circle whose diameter is 132 feet.

3. Find (by Practice) the cost of 157 cwt. at £2 16*s*. 8*d*. per cwt.

4. Find the simple interest on £533 6*s*. 8*d*. for 146 days at 3 per cent. per annum.

5. Add together $5\frac{3}{7}$, $4\frac{1}{28}$, $\frac{13}{21}$, and $\frac{5}{98}$.

6. Subtract $6\frac{7}{12}$ from $10\frac{1}{3}$.

7. Multiply $15\frac{3}{4}$ by $\frac{15}{28}$.

8. Divide $13\frac{1}{8}$ by $4\frac{2}{3}$.

9. Add together 216·005, ·002604, 845, and 6914·02.

10. Subtract 36·978 from 500·32105.

11. Multiply 216·79 by 750.

12. Divide 34·015 by 701·5 to four places of decimals.

13. Reduce 1·0165 of an acre to square yards.

14. In 237164 feet how many miles, furlongs, poles, &c.?

15. How long will 40 men take to build a wall 10 feet high, if 11 men require 17 days to build one the same length, but only $7\frac{1}{2}$ feet high?

16. Find (by Practice) the dividend on £1816 13*s.* 4*d.* at 15*s.* $3\frac{3}{4}$*d.* in the £.

17. Find the compound interest on £4500 in 3 years at 6 per cent. compound interest (neglecting fractions of a penny).

18. Add together $3\frac{5}{8}$, $\frac{3}{5}$, $17\frac{19}{20}$, and $\frac{3}{4}$.

19. Subtract $12\frac{7}{8}$ from $19\frac{3}{28}$.

20. Multiply together $3\frac{5}{6}$, $\frac{15}{92}$, $1\frac{3}{4}$, and $\frac{8}{21}$.

21. Divide $8\frac{5}{7}$ by $12\frac{1}{8}$.

22. Add together 38·9126, ·005169, 3·0012, and 648·03.

23. Subtract 623·92842 from 1005·6123.

24. Multiply 319·12 by ·0016.

25. Divide 485976·5 by 20·165.

26. Reduce 253 yards to the decimal of 5 miles.

27. Find the square root of (i.) 15661·521316, (ii.) of $62\frac{133}{567}$.

28. The sum of £533 6*s.* 8*d.* is received for £560 due two years hence; at what rate is discount calculated?

*29. Divide £2025 among A, B, C, D, and E, so that A's share is to B's share as 1 : 2; C's share to B's share as 5 : 4; D's share to C's share as 6 : 5; and E's share to D's share as 4 : 3.

30. A grocer buys coffee at the rate of £8 10*s.* per cwt., and chicory at £2 10*s.* per cwt., and mixes them in the proportion of 5 parts chicory to 7 coffee; at what rate per lb. must he sell the mixture so as to gain $16\frac{2}{3}$ per cent. on his outlay?

31. Three sacks contain equal quantities of wheat, barley, and oats, and a mixture is formed by taking 50 per cent. from the first sack, 30 per cent. from the second, and 70 per cent. from the third; find what percentage of the whole quantity of corn is taken away.

32. Two clocks point to 8 o'clock at the same instant on the morning of New Year's Day; one loses 6 seconds, and the other gains 10 seconds in 24 hours; when will one be half an hour before the other, and what time will each clock then show?

LXXIV.

1. In 1370695 ounces how many tons, cwt., quarters, and pounds are there?

2. How many persons in 14 days can do as much work as it takes 21 persons to accomplish in 4 days?

3. Find (by Practice) the dividend on £5146 15*s.* at 17*s.* 9*d.* in the pound.

4. Find the simple interest on 200 guineas for 4 years 7 months and 25 days at $4\frac{1}{2}$ per cent. per annum.

5. Add together $1\frac{5}{9}$, $3\frac{7}{15}$, and $\frac{13}{25}$.

6. Subtract $5\frac{2}{7}$ from $6\frac{4}{21}$.

7. Multiply $3\frac{6}{13}$ by $\frac{26}{115}$.

8. Divide $\frac{1}{7}$ by $3\frac{4}{21}$.

9. Add together ·602604, 845, 6914·02, and 71·935.

10. Subtract 43·78126 from 509·7.

11. Multiply 361·42 by ·00685.

12. Divide 61·0284 by ·3501 to four places of decimals.

13. Reduce 30 square yards to the decimal fraction of a rood.

14. Reduce 13 miles 4 furlongs 5 poles to yards.

15. If 7 bushels of corn will serve 3 persons 10 weeks, and it be sold at 65*s.* the quarter, what will be the cost of providing for 2 persons for 6 weeks?

16. Find (by Practice) the value of 5 quarters 3 bushels 1 peck of oats at £1 14*s.* 8*d.* per quarter.

17. Find the amount at compound interest of £3546 in three years at 5 per cent. per annum (neglecting fractions of a penny).

18. Add together $4\frac{7}{12}$, $\frac{8}{9}$, $\frac{7}{16}$, and $6\frac{5}{48}$.

19. Subtract $14\frac{4}{13}$ from $19\frac{3}{32}$.

20. Multiply together $\frac{7}{8}$, $5\frac{1}{9}$, $1\frac{7}{23}$, and $\frac{24}{49}$.

21. Divide $13\frac{3}{4}$ by $5\frac{1}{2}$.

22. Add together 3·0012, 648·63, 9473·99, and ·0006832.

23. Subtract 143·78065 from 8400.

24. Multiply 43·2568 by 720.

25. Divide ·003168 by ·000045.

26. Express ·45895 lbs. Troy in ounces, pennyweights, grains, and the decimal fraction of a grain.

27. Find (i.) the square root of 100·861849, and (ii.) the cube root of 12812904.

28. What is the present worth of a bill for £682 18*s*. $9\frac{1}{2}$*d*., due in 3 years 9 months, discount being allowed at the rate of $4\frac{1}{2}$ per cent. per annum?

29. If 5 persons contribute 60 dollars each, and employ 72 per cent. of their capital in the purchase of sugar at 18*s*. for 28 lbs.; then if dollars be exchanged at 4*s*. 2*d*. each, what proportion of a ton of sugar will they obtain?

30. A vessel is sent to the Arctic Ocean to catch whales, and the captain, who is entitled to $\frac{1}{18}$ of the entire produce of oil, receives, at the end of a 4 years' voyage, £730. Supposing the oil to be worth 60 guineas per tun (each whale, on an average, yielding 6 tuns), also the crew to have been two-thirds of the entire period on the look-out, what was the average number of days between the capture of each whale?

31. On what days of the week will the 10th of February fall in the years 1960 and 2060? Explain the calculations by which you obtain your results in this question.

LXXV.

1. Add together $2\frac{1}{16}$, $3\frac{3}{10}$, $\frac{7}{32}$, and $2\frac{1}{8}$.
2. Subtract $7\frac{4}{9}$ from $12\frac{3}{7}$.
3. Multiply together $5\frac{1}{6}$, $2\frac{5}{8}$, $\frac{4}{7}$, and $3\frac{3}{22}$.
4. Divide $7\frac{4}{7}$ by $7\frac{4}{17}$.
5. Add together 53·6282, 73·50036, 9·9625, and ·007.
6. Subtract 4·147283 from 30·0721.
7. Multiply ·02634 by 30·24.
8. Divide 9·065 by 1·225.
9. Express 1*s*. 3*d*. as the decimal of £3 15*s*.
10. Add together $5\frac{1}{7}$, $2\frac{15}{63}$, $7\frac{1}{3}$, and $\frac{11}{21}$.
11. Subtract $24\frac{1}{6}$ from $30\frac{3}{15}$.
12. Multiply together $\frac{2}{7}$, $3\frac{6}{11}$, $1\frac{5}{39}$, $2\frac{4}{15}$, and $1\frac{5}{51}$.
13. Divide $7\frac{1}{40}$ by $4\frac{1}{40}$.
14. Add together ·172 of 3*s*. 9*d*. and ·072 of a guinea, and give the answer in pence and the decimal fraction of a penny.

15. Subtract 2·875 oz. from ·2875 lbs. Avoirdupois.

16. Multiply ·2685 by ·48.

17. Divide 46·732 by ·07.

18. Reduce 8·04 dwts. to the decimal of a pound Troy.

19. Reduce 4 miles 3 furlongs 15 poles 2 feet to feet.

20. A creditor receives £173 15*s.* 6*d.* from the estate of a bankrupt paying 15*s.* 9*d.* in the £; what was the original debt?

21. Find (by Practice) the dividend on £8376 5*s.* at 13*s.* 7*d.* in the £.

22. Find the simple interest on £1760 for 4 years at 5¼ per cent. per annum.

23. In 14365925 pints of wine how many hogsheads, gallons, &c.?

24. If a 4 lb. loaf costs 6*d.* when wheat is 52*s.* a quarter, what ought a ninepenny loaf to weigh when wheat is 65*s.* a quarter?

25. Find (by Practice) the cost of 3 qrs. 3 bushels 1 peck of oats at 4*s.* 4*d.* a bushel.

26. Find the amount of £2380 in 3 years at 5 per cent. per annum, compound interest (neglecting fractions of a penny).

27. Find the cost of painting the four walls of a room at 10*d.* a square yard, the length of the room being 18 ft. 10¼ in., the breadth 17 ft. 1¾ in., and the height 12 ft. 3 in.

28. From the following table—

RAILWAY PASSENGERS.	GREAT BRITAIN.	FRANCE.	PRUSSIA.
1st class	4743210	2124910	307490
2nd class	10291740	6172420	1292470
3rd class	21409210	15473550	2374230

find the proportion per cent. which the whole number of third-class passengers bears to the number of first and second-class passengers in France and Prussia together.

29. If the 3 per cent. Consols be at 93⅛, what sum of money must be expended in the purchase of stock in order to obtain an income of £552 a year?

If the purchaser afterwards sells out at 95 and invests the proceeds in mortgages at 4 per cent. per annum, what will be the increase in his income?

30. What must be the dimensions of a rectangular cistern of which the base is square and the depth equal to a quarter of a side of the base, in order that it may contain 19321 gallons of water, each gallon containing 278 cubic inches?

31. An event occurred 40,000 days preceding January 1st, 1871. Find the year, and the month, the day of the month, and the day of the week on which it happened.

LXXVI.

1. Add together 5, $3\frac{1}{8}$, $\frac{5}{16}$, $\frac{7}{13}$, and $\frac{1}{5}$.
2. Subtract $7\frac{7}{17}$ from $10\frac{1}{4}$.
3. Multiply together $5\frac{1}{2}$, $\frac{3}{17}$, $\frac{5}{22}$, $1\frac{1}{16}$, and $\frac{3}{4}$.
4. Divide $7\frac{1}{8}$ by $9\frac{1}{2}$.
5. Add together 19·735, ·000756, 4732·92, and ·375499.
6. Subtract 876·93287 from 974·3217.
7. Multiply 9·238 by 65·2.
8. Divide 2·890721925 by ·0729.
9. Express 5*s.* 3*d.* as the decimal of £7.
10. Add together $4\frac{1}{5}$, $7\frac{13}{14}$, $9\frac{1}{8}$, and $1\frac{1}{35}$.
11. Subtract $34\frac{9}{20}$ from $100\frac{3}{8}$.
12. Multiply together $8\frac{2}{9}$, $45\frac{25}{37}$, $1\frac{1}{13}$, $\frac{81}{130}$, and $\frac{1}{14}$.
13. Divide $8\frac{3}{21}$ by $5\frac{1}{7}$.
14. Add together 1·35 of a furlong and 7·32 of a yard, and give the answer in feet and the decimal fraction of a foot.
15. Subtract 2·32 of an hour from ·65 of a week.
16. Multiply 380·73 by ·0725.
17. Divide 7·036 by ·073 to four places of decimals.
18. Express 2 cwt. 3 qrs. 14 lbs. as the decimal of a ton and a half.
19. Reduce 15 lbs. $13\frac{1}{2}$ oz. 12 dwts. to grains.
20. If 5 hogsheads, each weighing 7 tons 3 cwt. 3 qrs. $16\frac{4}{5}$ lbs., cost £239 6*s.* 6*d.*, what is that per ton?
21. Find (by Practice) the dividend on £731 14*s.* 6*d.* at 14*s.* 2*d.* in the £.
22. Find the simple interest on £4160 for $6\frac{1}{4}$ years at 3 per cent. per annum.

23. In 5432762 square feet how many acres, roods, &c., are there?

24. If 20 men can mow a field of 9 acres 2 roods in $8\frac{1}{2}$ days of 10 hours each, how many fields of twice this area can 17 men mow in 50 days of 8 hours each?

25. Find (by Practice) the value of 2 tons 5 cwt. 3 qrs. $3\frac{1}{2}$ lbs. at £3 13*s.* 6*d.* per cwt.

26. In what time will £3125 amount to £3681 12*s.* $9\frac{3}{4}$*d.* at $3\frac{3}{4}$ per cent. simple interest?

27. A grocer mixes 3 cwt. of tea which cost him 16 guineas a cwt. with one cwt. which cost him £19 12*s.* At what rate per pound must he sell the mixture so as to gain 4 per cent. on his outlay?

28. Find the length of the edge of a cube which contains 450 cubic feet 1088 cubic inches.

29. From the following table—

RAILWAY PASSENGERS.	GREAT BRITAIN.	FRANCE.	PRUSSIA.
1st class	4743210	2124910	307490
2nd class	10291740	6172420	1292470
3rd class	21409210	15473550	2374230

find the proportion per cent. which the whole number of second-class passengers bears to the number of first and third-class passengers in Great Britain and Prussia together.

30. Find the value of $5{\cdot}4\dot{9}$ of ${\cdot}03\dot{1}\dot{8}$ of ${\cdot}\dot{0}4761\dot{9}$ of twenty-five guineas.

LXXVII.

1. Add together $3\frac{2}{3}$, $\frac{2}{7}$, $\frac{1}{4}$, and $1\frac{3}{8}$.
2. Subtract $9\frac{1}{9}$ from $12\frac{1}{10}$.
3. Multiply together $2\frac{1}{3}$, $\frac{1}{4}$, $\frac{5}{14}$, and $4\frac{1}{2}$.
4. Divide $6\frac{5}{7}$ by $7\frac{5}{8}$.
5. Add together 73·50036, 9·9625, ·007, and ·03072.
6. Subtract 31·928734 from 50·17328.
7. Multiply 30·24 by ·0334.
8. Divide 293·46 by ·438.

9. Express half-a-crown as the decimal of a guinea.

10. Add together $\frac{1}{20}$, $3\frac{1}{8}$, $1\frac{1}{6}$, and $\frac{2}{9}$.

11. Subtract $16\frac{2}{19}$ from $20\frac{1}{20}$.

12. Multiply together 13, $2\frac{6}{11}$, $\frac{1}{7}$, $\frac{2}{39}$, and $\frac{5}{32}$.

13. Divide $6\frac{7}{20}$ by $6\frac{7}{40}$.

14. Add together 1·23 of a crown and 5·37 of a florin, and give the answer in pence and the decimal fraction of a penny.

15. Subtract ·125 of an hour from ·03 of a day.

16. Multiply ·3728 by ·283.

17. Divide ·56277 by 507.

18. Reduce $\frac{7}{8}$ of a pound Avoirdupois to the decimal of a hundredweight.

19. Reduce 13 acres 12 perches to square yards, feet, and inches.

20. How many yards of carpet $\frac{3}{4}$ yard wide will cover a room whose width is 15 feet and length 18 feet?

21. Find (by Practice) the dividend on £9306 15*s.* at 16*s.* 10*d.* in the pound.

22. Find the simple interest on £3825 for 15 years at $6\frac{1}{2}$ per cent. per annum.

23. In 14365925 seconds how many weeks, days, hours, &c.?

24. If the 4*d.* loaf weighs 14 oz. when wheat is 63*s.* a quarter, what should be the weight of the 6*d.* loaf when wheat is 84*s.* a quarter?

25. Find (by Practice) the cost of 48 cwt. 3 qrs. $3\frac{1}{2}$ lbs. of sugar at 24*s.* per cwt.

26. At what rate per cent. will £3745 amount to £3932 5*s.* in two years, simple interest?

27. Extract the cube root of (i.) 512768384064, (ii.) $42\frac{7}{8}$.

28. Find the least common multiple of 1547, 1729, and 4199; and add together $\frac{7}{2431}$, $\frac{8}{2717}$, and $\frac{10}{4199}$.

29. How much £100 stock at $92\frac{2}{3}$ must be sold out to pay a bill of £954 9*s.* 4*d.*, due 9 months hence, at 4 per cent. per annum?

30. Add together $\frac{3}{4}$ of $\frac{5}{9}$ of £2 5*s.*, $\frac{2}{7}$ of 5 guineas, $4\cdot\dot{3}\dot{6}$ of £1 18*s.* 6*d.*, and $4\cdot3\dot{0}\dot{9}$ of £2 15*s.*, and reduce the result to the decimal of 30 guineas.

LXXVIII.

1. Add together $3\frac{7}{10}$, $\frac{11}{15}$, $1\frac{13}{18}$, and $\frac{17}{20}$.
2. Subtract $5\frac{5}{6}$ from $8\frac{2}{27}$.
3. Multiply together 15, $\frac{7}{11}$, $\frac{22}{5}$, and $\frac{9}{14}$.
4. Divide $13\frac{1}{3}$ by $2\frac{26}{27}$.
5. Add together 34·25, 235·632, ·00685, and 1400·06.
6. From 1000·423 take 836·0982.
7. Multiply 652·394 by ·0476.
8. Divide 219·46232 by ·03542.
9. Express 5*s.* $1\frac{3}{4}$*d.* as the decimal of £5 2*s.* 11*d.*
10. Add together $9\frac{1}{5}$, $\frac{4}{21}$, $\frac{3}{35}$, and $\frac{11}{12}$.
11. Subtract $3\frac{11}{18}$ from $6\frac{11}{20}$.
12. Multiply together $\frac{2}{3}$, $3\frac{1}{4}$, 15, and $\frac{9}{20}$.
13. Divide $14\frac{124}{231}$ by $4\frac{14}{33}$.
14. Add together ·542 of an hour and 10·864 of a minute, and give the answer in seconds and the decimal fraction of a second.
15. Subtract 9·15 of a grain from 3·0565 of an ounce.
16. Multiply 30·96 by 43·8.
17. Divide ·03796 by 365.
18. Reduce ·0162 of 4*s.* 6*d.* to farthings and the decimal of a farthing.
19. Reduce 11 quarters 7 bushels 3 quarts to pints.
20. What weight of sugar can be bought for £187 4*s.* if 13 cwt. cost £55 9*s.* 4*d.*?
21. Find (by Practice) the dividend on £5069 10*s.* at 14*s.* $11\frac{1}{2}$*d.* in the pound.
22. Find the simple interest on £4000 for 3 years at $5\frac{1}{2}$ per cent. per annum.
23. Reduce 1468935 inches to miles, furlongs, poles, &c.
24. If I get 1 lb. of bread for 1*s.* when wheat is 6*s.* a bushel, what should be the price of wheat per quarter when I get 12 oz. of bread for 4*d.*?
25. Find (by Practice) the value of 2 roods 19 poles 19 square yards of land at £40 6*s.* 8*d.* an acre.
26. Find the amount of £3750 for 3 years at 6 per cent. per annum, compound interest.

*27. A can dig a certain length of ditch in 3 days, B can do the same in 4 days, and C in 5 days. How long will it take them all together to dig the same length of ditch? and what proportion of the work will be done by each?

28. A prize of £2770 was divided amongst three persons in the proportion of $\frac{3}{4}$, $\frac{14}{15}$, and $\frac{5}{8}$. What were their respective shares of the prize?

29. A pond whose area is 3 acres is frozen over with ice to the uniform thickness of 6 inches. If a cubic foot of ice weighs 896 oz. Avoirdupois, find the weight of ice on the pond in tons.

*30. Find the square root of ·0043046721, and the cube root of 40·353607.

31. A merchant sells tea to a tradesman at a profit of 60 per cent.; but the tradesman becoming bankrupt, pays only 2*s.* 6*d.* in the £. How much per cent. does the merchant gain or lose by his sale?

LXXIX.

1. Add together $5\frac{2}{7}$, $\frac{2}{35}$, $4\frac{9}{10}$, and $\frac{11}{12}$.
2. Subtract $3\frac{14}{15}$ from $5\frac{13}{18}$.
3. Multiply together $3\frac{29}{30}$, $2\frac{14}{23}$, $\frac{9}{14}$, and $2\frac{1}{34}$.
4. Divide $7\frac{2}{3}$ by $\frac{15}{16}$.
5. Add together 896·51, ·00867, 1·92, and ·806.
6. From 1046·201 take 345·0629.
7. Multiply 762·81 by ·0047.
8. Divide 8224·6385 by 170·3.
9. Express $\frac{3}{5}$ of 12*s.* 6*d.* as the decimal of £40.
10. Add together $1\frac{7}{15}$, $\frac{27}{35}$, $4\frac{5}{7}$, and $\frac{29}{70}$.
11. From $6\frac{11}{40}$ take $5\frac{7}{9}$.
12. Multiply together $2\frac{6}{7}$, $\frac{14}{15}$, $5\frac{1}{3}$, and $7\frac{7}{8}$.
13. Divide $5\frac{7}{8}$ by $6\frac{13}{16}$.
14. Add ·527 of a bushel to 1·836 of a gallon, and give the answer in pints and the decimal fraction of a pint.
15. From 1·0045 of a pound Troy take 9·75 of an ounce.
16. Multiply 409·7 by 65·02.
17. Divide ·0004743 by ·144.
18. Reduce ·50612 of 2*s.* 8$\frac{3}{4}$*d.* to farthings and the decimal of a farthing.

19. Reduce 5 tons 3 cwt. 2 qrs. 13 lbs. to ounces.

20. A field of 8 acres produces 220 bushels of wheat, how much is that upon 22 square yards?

21. Find (by Practice) the cost of 455436 articles at £1 17*s.* 11¾*d.* per dozen.

22. In what time will £1637 16*s.* 8*d.* amount to £2129 3*s.* 8*d.* at 3¾ per cent. per annum, simple interest?

23. In 946345 inches how many miles, furlongs, &c.?

24. If 20 men dig 30 yards of earth in 4 days, how many yards can be dug by 40 men in 6 days?

25. Find (by Practice) the value of 7 qrs. 3 bushels 3 pecks of wheat at £5 4*s.* a quarter.

26. Find the amount at compound interest of £3670 in 3 years at 6 per cent. per annum (neglecting fractions of a penny).

27. Find the square root of 8264·446281, and the cube root of ·300405224.

28. A river 30 feet deep and 200 yards wide flows 4 miles an hour; find the number of cubic feet of water that falls into the sea in a minute; also its weight in tons.

(1 cubic foot = 1000 oz.)

29. Two clocks are at 12 the same instant; one loses 7″ and the other gains 8″ in 24 hours; when will one be half an hour before the other, and what time will each clock then show?

30. A cistern has two pipes, one of which can fill it in 2, the other in 3 hours. A third pipe can empty it in 5 hours. If while the cistern is empty all these are opened, in what time will it be filled?

ENGINEER STUDENTS IN THE ADMIRALTY.

(Two and a half hours.)

LXXX.

*1. Write out in words 9000735006.

2. Write down in figures five million fifteen thousand and five.

3. Write down in figures thirty thousand twelve hundred and eighty.

4. Add together

12489307
34567890
5729011
2357109
90463295
10639042
12839476
77690379
462183921
803672897

5. Add together

£	s.	d.
5632	4	2
4187	16	6½
437	15	7½
596	13	1¾
5910	7	8
4728	6	11
59	12	10¾
19403	13	8
27391	4	6½
40572	16	4

6. From £824019 8*s.* 4½*d.* take £38274 13*s.* 9¾*d.*

*7. Multiply 940213 by 607004.

8. Multiply £7048 11*s.* 3¼*d.* by 92.

9. Divide £560127 17*s.* 9¾*d.* by 45.

10. Divide £226125587 3*s.* 5½*d.* by 602.

11. Reduce 2 tons 7 cwt. 2 qrs. 11 lbs. to ounces.

12. If 17 yards of cloth cost £6 12*s.* 8½*d.*, what will 110½ yards cost?

13. Find (by Practice) the dividend on £2870 10*s.* at 14*s.* 3*d.* in the £.

14. Find the simple interest on £3260 for 4 years at 2½ per cent. per annum.

15. What is the income corresponding to an income-tax of £59 1*s.* 3*d.* at the rate of 5*d.* in the £?

16. In 370652308 square inches how many acres, roods, perches, &c.?

17. Add together $2\frac{1}{6}$, $5\frac{1}{5}$, $\frac{3}{20}$, and $1\frac{1}{40}$.

18. Subtract $7\frac{3}{16}$ from $9\frac{1}{20}$.

19. Multiply together $3\frac{7}{9}$, $\frac{5}{34}$, $1\frac{3}{16}$, $2\frac{4}{7}$, and $1\frac{1}{10}$.

20. Divide $6\frac{1}{17}$ by $\frac{5}{21}$.

21. Add together ·55 of 7*s.* 6*d.* and 5·32 of 17*s.* 3*d.*, and give the answer in pence and the decimal fraction of a penny.

22. Subtract 2·63 dwts. from 12·13 oz. Troy.

23. Multiply ·4302 by ·206.

24. Divide ·00256 by ·8192.

25. Divide 21·84 by ·168.

26. Express 13 minutes $7\frac{1}{2}$ seconds as the decimal of an hour.

27. If 200 men in 12 days of 8 hours each can dig a trench 160 yards long 6 wide and 4 deep, in how many days of 10 hours will 90 men dig a trench 450 yards long 4 wide and 3 deep?

28. A person on leaving England exchanged his money for French money at the rate of 25 francs for a sovereign, and on arriving at Munich received 135 Bavarian gulden for 300 francs. What was his loss (i.) in English, (ii.) in French money, supposing a gulden to be worth 1*s.* $8\frac{1}{2}$*d.*?

29. Find the number of yards in the side of a square park containing 109 acres 3 roods 8 perches and 9 square yards.

30. A postman has 10 miles to walk in 3 hours, and he walks the first 4 miles at the rate of $3\frac{3}{4}$ miles an hour, the next two at the rate of $3\frac{1}{3}$ miles an hour, and the next mile at the rate of 3 miles an hour. At what rate must he walk the rest in order to finish his journey at the proper time?

LXXXI.

*1. Write out in words the number 806030075.

2. Write down in figures two hundred million eleven thousand and fifty.

3. Write down in figures sixty million thirteen thousand and ninety.

4. Add together

899794
54576687
15729014
2357211
54344123
71203496
63857905
12345678
934893494
807673897

5. Add together

£	*s.*	*d.*
3621	14	6½
48753	16	6½
3437	5	7½
10596	13	4¾
199	17	7
32934	6	11½
1059	13	10
16839	17	9½
49374	4	6½
49573	16	5

6. From £297630 11*s.* 8½*d.* take £134973 15*s.* 11¾*d.*

7. Multiply 848373 by 30657.

8. Multiply £247 13*s.* 5¼*d.* by 64.

9. Divide £1315314 17*s.* 2½*d.* by 49.

10. Divide £118332 19*s.* 5¼*d.* by 321.

11. Reduce 2 lbs. 3 oz. 5 dwts. to grains.

12. If 3 tons 5 cwt. 2 qrs. cost £1 12*s.* 9*d.*, what is the value of 70 lbs.?

13. Find (by Practice) the dividend on £6421 15*s.* at 13*s.* 9*d.* in the pound.

14. Find the simple interest on £2600 for 4½ years at 3½ per cent. per annum.

15. If 3 men and 2 boys do a piece of work in 24 days, how long will it take 2 men and 3 boys to do the same, the work of 2 men being equal to that of 3 boys?

16. In what time will £1300 amount to £1493 7*s.* 6*d.* at 3½ per cent. per annum, simple interest?

17. Add together $6\frac{2}{3}$, $\frac{5}{11}$, $3\frac{1}{4}$, and $\frac{7}{15}$.

18. Subtract $7\frac{13}{22}$ from $11\frac{3}{40}$.

19. Multiply together $6\frac{7}{8}$, $\frac{4}{11}$, $\frac{7}{20}$, and $1\frac{1}{7}$.

20. Divide $12\frac{3}{14}$ by 9.

21. Add together 504·926, 1125·2843, ·00256, and 29·633.

22. Subtract 28·92587 from 50·20735.

23. Multiply 11·5792 by ·0946.

24. Divide 403 by ·248.

25. Divide 1·62 by 675.

26. Reduce ·3473 of 1 ton 3 cwt. to pounds and the decimal of a pound.

27. Find the square root of $516\frac{348}{361}$, and the cube root of 474·552.

28. Find the value of $\cdot 33\dot{9} \times 2\frac{16}{17} \div 6\cdot 48$.

29. If I invest £3591 in 3 per cent. Consols at $85\frac{1}{2}$, what income shall I derive from them, and what interest per cent. shall I get on the money invested?

30. A runs a two-mile race with B, and loses. Had he run a third quicker, he would have won by 22 yards. Compare the rate at which each ran.

HOME CIVIL SERVICE.

HIGHER ARITHMETIC.

(Three hours.)

LXXXII.

1. A man has £576 6*s*. 8*d*. per annum after paying income-tax at the rate of 4*d*. in the pound; what is his income?

2. Find the price of 3 acres 1 rood 7 perches and 88 square yards at £161 6*s*. 8*d*. per acre.

*3. Find the difference between the Interest and Discount on £7747 5*s*. for six months, reckoning 5 per cent. simple interest.

4. Find the length of the edge of a cube which contains 3605 cubic feet 64 cubic inches.

5. A man leaves one-third of his property to his widow and one-half to his son, who gets £326 more than either of his four sisters, between whom the residue is divided equally; what is the whole sum left?

6. A person who has £1010 stock in a railway company, guaranteed to pay 5 per cent. per annum, receives for his half year's dividend the guaranteed interest and a further bonus of 5*s*. 3*d*. per cent. for the half year; find the amount of his dividend when an income-tax of 5*d*. in the pound has been deducted from it.

7. Multiply, by duodecimals, 8 ft. 7 in. 2 pts. by 5 ft. 7 in. 11 pts., and the product by 3 ft. 7 in. What does the product become when expressed in cubic feet, cubic inches, and a fraction of a cubic inch?

8. A room is 16 ft. 7in. long, 13 ft. 5 in. wide, and 10 ft. 6 in. high; find the cost of papering it with paper 1 ft. 8 in. wide, at 10*d*. per yard; and of carpeting it with carpet $\frac{3}{4}$ yd. wide at 4*s*. 2*d*. per yard.

9. The railway fare from London to Dover (70 miles) being 14*s*. 7*d*., and that from Paris to Boulogne (240 kilo-

metres) being 38·16 francs; compare the cost of travelling in England and France, the French metre being equal to 3 feet 3·37168 inches, and the English sovereign being worth 25·44 francs.

10. The mean temperature from the 9th to the 16th January, 1871, both days inclusive, was 34·6°, and from the 10th to the 17th it was 39·8°; the mean temperature on the 9th was 30·5°; what was it on the 17th?

11. What advantage does a man gain who, owing £1000 at the present time, is allowed to extend the settlement of his debt over the next twelve months, by making four equal quarterly payments, simple interest to be calculated at the rate of 5 per cent. per annum?

12. If a piece of work can be finished in 45 days by 35 men, and if the men drop off by 7 at a time at the end of every 15 days, how long will it be before the work is finished?

13. The gross receipts of a railway company in a certain year are apportioned as follows: 41 per cent. to pay the working expenses, 56 per cent. to give the shareholders a dividend at the rate of 3½ per cent. on their shares; and the remainder, £15000, is reserved; find the paid-up capital of the company.

14. Prove, without using the common rule for the extraction of the square root, that $2{\cdot}7\dot{6}$ is the square root of $7{\cdot}65\dot{4}$.

15. A person in London owes another in St. Petersburg 460 roubles, which must be remitted through Paris. He pays the requisite sum to his broker when the exchange between London and Paris is 23 francs for £1, and between Paris and St. Petersburg 2 francs for one rouble. The remittance is delayed until the rates of exchange are 24 francs for £1 and 3 francs for 2 roubles. What does the broker gain or lose by the transaction?

LXXXIII.

1. Find to three places of decimals the square root of ·4; what number has ·04 for its square root?

2. Find the cost of painting the four walls of a room at *2s. 3d.* per square yard, the height being 15 feet, width 16 feet, and length 18 feet.

3. Find what weight of water would fall (i.) on an acre

(ii.) on a square mile, in a country where the rainfall is half an inch.

4. If A can do a piece of work in 6 days, B in 8 days, and C in 9 days, in how many days would all three working together finish it?

5. A man travels 60 miles in 3 hours, partly by rail and partly by coach, but if he had gone all the way by rail he would have ended his journey an hour sooner, and saved two-fifths of the time he was on the coach; how far did he go by coach?

6. The population of three towns in 1861 was respectively 22368, 43415, and 10632. In 1871 the two former had increased 6 per cent. and 8 per cent. respectively, and the latter decreased 10 per cent.; find the average population.

7. Multiply, by duodecimals, 15 feet 1 inch 3 parts by 8 ft. 7 in. 4 pts., and the product by 6 ft. 3 in.; what does the answer become when expressed in cubic feet, cubic inches, and a fraction of a cubic inch?

*8. By selling a horse for £42 10*s.* a person lost 7½ per cent.; find the gain or loss per cent. by selling him for £48 5*s.*

9. Find (correct to an inch) the diagonal of a square field containing four acres.

10. A person invests £1870 in a 9 per cent. Japanese loan, which was issued at 98 per cent. at 3⅞ premium; how much stock will he have, and what rate of interest will the investment give?

11. The area of a rectangular field is 87 acres 1 rood 26 poles; find the length, the breadth being 925 links.

12. The cost price of a book is 11*s.* 3*d.* If the expense of sale be 8 per cent. upon this, and the profit 22 per cent., what would be the retail price?

13. Reduce to a decimal, correct to 7 places—

$$\frac{1}{1\cdot2}+\frac{1}{1\cdot2\cdot3}+\frac{1}{1\cdot2\cdot3\cdot4}+\frac{1}{1\cdot2\cdot3\cdot4\cdot5}\ \text{\&c.}$$

14. If the 3 per Cents are at 95, and Government offer to receive a loan of £5000000, the lender to receive five millions in the 3 per Cents, together with a certain sum in the 3¼ per cent. Stocks, what sum in the 3¼ per Cents ought the lender to accept?

LXXXIV.

1. What decimal of £4 3*s.* 4*d.* is $\frac{1}{2600}$ of £10 16*s.* 8*d.*?

2. Reduce 186 yards 2 feet $8\frac{1}{25}$ inches to the decimal of a chain (22 yards). If 1 chain = 10 chainlets = 100 links = 1000 linklets, express the above in chains, chainlets, links, and linklets.

3. If gold weighs 19·3 times as much as water, and copper 8·89 times as much, find how many times heavier than water is a coin which contains 11 parts of gold and 1 of copper.

4. Supposing the quick-time or step in marching to be 2 paces per second, and the length of each pace to be 28 inches, find the time in which a regiment will march 35 miles.

5. A merchant sells tea to a tradesman at a profit of 60 per cent.; but the tradesman becoming bankrupt pays only 2*s.* 6*d.* in the pound. How much per cent. does the merchant gain or lose by the sale?

6. Multiply, by duodecimals, 6 ft. 1 in. 3 pts. by 8 ft. 7 in. 2 pts., and the product by 8 ft. 7 in. What does the product become when expressed in cubic feet, cubic inches, and a fraction of a cubic inch?

7. Define Discount. Find the discount at 5 per cent. per annum on £100 due one year hence.

A person buys £800 Three per cent. Consols when they are at 85, and £500 more when they are at 97. How much per cent. will he get for his money, after deducting an income-tax of 7*d.* in the pound?

8. Find the length of the side of a square which is equal in area to the rectangle, the sides of which are 513 yds. 1 ft. 11 in. and 1628 yds. 11 in.

9. Find exactly the cube root of $1277289\frac{27}{216}$.

10. How many yards of carpet $2\cdot1\dot{6}$ yards wide will cover a room $25\cdot\dot{3}$ feet broad and $28\cdot\dot{8}$ feet long?

11. If a metric system of area were adopted, so that 2 acres 2 roods 6 perches would be represented by 5·12, express the unit of measurement in square yards and decimal parts of a square yard.

*12. If 75 men can perform a piece of work in 12 days of 10 hours each, how many men will perform a piece of work twice as large in a tenth part of the time if they work the same number of hours in the day, supposing that two of the second set can do as much work in an hour as three of the first set?

13. Find the sum which must be invested in the Three per Cents, at 90, at simple interest payable half-yearly, to amount in 23½ years to £2317 money, the price of the funds remaining unchanged. If the funds rose to 96, in how many years sooner could the required amount be realised?

14. In a school the numbers for the week were :—Monday morning 67, Tuesday morning 60, Wednesday morning 65, Thursday morning 68, Friday morning 62, Monday afternoon ·5 more than the average of Monday and Tuesday mornings, Tuesday afternoon 59, Wednesday afternoon ·5 less than the average of Tuesday, Thursday the average of Monday morning and Tuesday afternoon, Friday afternoon 60. Find the average attendance for the week.

15. Fifty cards, of which one is marked, are dealt round to form five heaps, and the heaps are then piled one on the other in such order that the heap containing the marked card is the middle one; the pack so made is again dealt round in five heaps, and the heaps piled as before; if now the pack be dealt in two heaps, show that the marked card will be the thirteenth in the heap which contains it.

LXXXV.

1. A man has £642 6*s.* 8*d.* per annum after paying income-tax at the rate of 4*d.* in the pound. What is his income?

2. Find the price of 5 acres 3 roods 7 perches and 88 square yards at £161 6*s.* 8*d.* per acre.

3. Find the difference in yards and fractions of a yard between 30 chains 15 links and 3 furlongs 6 rods.

4. If a person selling sugar at 4¾*d.* per lb. loses 10 per cent., what did he give per cwt.?

5. What is the present value of £455 12*s.* 6*d.*, due at the end of 4 years, at 5⅝ per cent. simple interest?

6. Find the cost of papering the four walls of a room 27 ft. 8 in. long, 21 ft. 4 in. broad, and 12 ft. high, the price of a piece of paper 12 yards long and $\frac{3}{4}$ yard broad being 4*s*. 6*d*.

7. Find within an inch the diagonal of a square field containing three acres and a half.

*8. Multiply, by duodecimals, 13 ft. 5 in. 7 pts. by 9 ft. 3 in. 11 pts. What does the product become when expressed in square feet, square inches, and a fraction of a square inch?

9. The price of £100 Bank Stock which pays $6\frac{1}{2}$ per cent. annual interest is $185\frac{5}{8}$; £6250 of this stock is transferred to the 3 per cent. Consols when the price of Consols is $92\frac{7}{8}$; find the loss in the annual interest, brokerage being neglected.

10. Find by duodecimals the height of a parallelopiped which contains 659 cubic feet 1248 cubic inches, and whose base is 26 feet 6 inches.

11. A cube contains $18\cdot\dot{9}6\dot{2}$ cubic yards. How many linear feet are there in (i.) an edge, (ii.) a diagonal? and what is the area of one of its faces?

12. A watch which is 10 minutes too fast at 12 o'clock on Monday loses 3 minutes and 10 seconds per day; what will be the time by the watch at a quarter past 10 on the morning of the following Sunday?

13. On the 15th of May, 1872, a person had lived 30000 days; find the year and day of the month of his birth.

14. Find the vulgar fraction in its lowest terms that is equal to the recurring decimal $10\cdot5624\dot{9}$, and show that its square root is $3\cdot24\dot{9}$.

15. In the French system of measurement the mètre or unit of length = 39·371 English inches. Find how many mètres, &c., there are in a mile, and how many yards in a kilomètre.
(1 kilomètre = 10 centimètres = 100 décamètres = 1000 mètres.)
What are the units of weight and of capacity in the French system of measurement?

LXXXVI.

1. Add together ·05735 of a mile and 46·25 yards, and reduce the result to the decimal of 7 furlongs.

2. A person invests £3395 in the 3 per cent. Consols at $84\frac{7}{8}$; find the income he derives therefrom, and the rate of interest he receives for his money.

3. If the price of coal be 42*s.* per ton, and the value of coal to the same weight of coke be in the ratio of 5 : 4, calculate the value of 10 chaldrons of coke, if 3 chaldrons = 2 loads, and each load weighs 21 cwt.

4. A detachment of cavalry consisted of 520 men after engaging in two battles, in the first of which it lost 1 man in every 25, and in the second $\frac{5}{18}$ of the remainder. Of how many men did the troop originally consist?

5. From two places, which are 154 miles apart, two persons set out to meet each other, one walking at the rate of 3 miles in 2 hours, the other 5 miles in 4 hours. When will they meet?

6. Find by duodecimals the cubical content of a tank 36 ft. 8 in. long, 7 ft. 11 in. broad, and 6 ft. 5 in. high, and express the result in cubic yards, feet, and inches.

7. Distinguish between interest and discount. Find the difference between the interest and discount on £908 5*s.* 9*d.* for 3 years at $4\frac{3}{4}$ per cent. per annum.

8. Find the square root of ·00694. Of what number is ·2 the square root?

9. Find the cube root of 11 to four places of decimals.

10. Two circular gold plates, each 1 inch thick, of which the diameters are respectively 6 and 8 inches, are melted into one plate an inch thick; find its diameter, having given that the area of a circle is proportional to the square of its radius.

11. The height of a solid six-inch cube is diminished by pressure to $5\frac{3}{8}$ inches; supposing the lateral expansion to be uniform throughout the mass, find, correct to three places of decimals, the length of one of the edges of the new case of the solid, whose volume is supposed to remain unaltered.

12. Find the exact time between 7 and 8 o'clock when the hands of a watch are together.

13. A rectangular grass-plot, the lengths of whose sides are in the ratio of 5 : 6, costs £16 11*s.* $6\frac{3}{8}$*d.* for turfing, at 5*d.* per square yard; find the lengths of its sides.

14. What principal put out at compound interest for 3 years at 5 per cent. would amount to £144 14*s.* $0\frac{3}{4}$*d.*?

15. If 60 cubic inches of lead, together with 54 cubic inches of cork, are equal in weight to $1538\frac{2}{3}$ cubic inches of fir, and the weights of equal quantities of lead and fir are represented by the numbers 11·324 and ·45; what number represents the weight of an equal quantity of cork?

LXXXVII.

1. Find the square root of 676·208016, and the cube root of 66·923416.

2. What do you mean by Discount? Find the true discount on £528 15*s.*, due four years hence, at $5\frac{3}{8}$ per cent.

*3. Find the average of $12\frac{19}{25}$, 21, $7\frac{3}{4}$, ·034, $3\frac{1}{8}$, 0, $24\frac{1}{2}$, and $12\frac{7}{20}$. Express the fractional part decimally.

4. If by selling goods for £136 I lose 16 per cent., how much per cent. should I have lost or gained if I had sold them for 160 guineas?

5. Add together $\frac{5}{32}$ of a square mile, $\frac{7}{10}$ of an acre, and $\frac{5}{8}$ of a rood, giving the result in acres, roods, and perches.

6. A person invests £6534 in the 3 per Cents at 90, and on their rising to 91 transfers his stock to the $3\frac{1}{2}$ per Cents at $93\frac{1}{2}$; how is his annual income affected?

7. The consumption of malt in a country is 7200000 qrs., and the duty is 16*s.* 6*d.* per quarter. If the duty be reduced 30 per cent., and the consumption then increases 20 per cent., how will the revenue be affected?

8. The sidereal year being 365 days 6 hours 9 min. 9 sec. 6, and the tropical year 365 days 5 hours 48 min. 49 sec. 7, reduce their difference to the decimal of a sidereal year.

9. After a certain number of men had been employed on a piece of work 24 days, and had half finished it, 16 men more were set on, and the remaining half was completed in

16 days; how many men were employed at first, and what was the whole expense of the work at 1*s.* 6*d.* a day per man?

10. Multiply 13 ft. 7 in. by 9 ft. 3 in., and the product by 2 ft. 5 in., and express the result in cubic feet, cubic inches, and the fractional part of a cubic inch.

*11. A room is 34 ft. 8 in. long, 13 ft. 6 in. wide, and 10 ft. 9 in. high. Find the cost of papering it with paper 1 ft. 10 in. wide, at 6*d.* per yard; and of carpeting it with carpet $\frac{3}{4}$ yard wide, at 3*s.* 4½*d.* per yard.

12. Reduce $\frac{5\cdot 1183}{\cdot 0141}$ of $22\cdot\dot{2}$ of $\cdot 0\dot{9}$ of $\cdot 2\dot{3}\dot{4}$ to a vulgar fraction in its lowest terms.

LXXXVIII.

1. If 40 men can mow a field of 19 acres in 8½ days of 10 hours each, how many acres can 17 men mow in 50 days of 8 hours each?

2. Extract the square root of 3914879761 and of $37\frac{212}{841}$.

3. Find the present value of £9393 18*s.* 4½*d.* due 5½ years hence at 3½ per cent. simple inrerest.

4. By selling a house for £4162 10*s.* a man lost 7½ per cent., how much per cent. would he have lost or gained if he had sold it for 4500 guineas?

5. A certain number of yards of carpeting, three quarters of a yard wide, just cover the floor of a room 16 ft. 8 in. long and 13 ft. 5 in. broad, leaving the hearth-stone, which is 4 ft. 2 in. long and 1 ft. 8 in. broad, uncovered. Find its price at 6*s.* a yard.

6. Find (i.) in chains and links, (ii.) in yards and feet, the diameter of a circle which contains an acre; the area of a circle being the square of the radius multiplied by 3·1416.

7. Find the length of the edge of a cube which contains 1520 cubic feet 1512 cubic inches.

8. Multiply, by duodecimals, 5 ft. 6 in. 4 pts. by 2 ft. 7 in. 3 pts., and the product by 6 ft. 5 in. What does the product become when expressed in cubic feet, cubic inches, and the fraction of a cubic inch?

9. If the 3 per cent. Consols be at 93⅛, what sum of money must be expended in the purchase of stock in order to obtain an income of £552 a year?

If the purchaser afterwards sells out at 95, and invests the proceeds in mortgages at 4 per cent. per annum, what will be the increase in his income?

10. A man pays rates and taxes to the amount of £22 15*s.* 7*d.*, made up as follows: (i.) Queen's taxes, 11*d.* in the £ on his rent; (ii.) parochial rates, an average per quarter of 1*s.* 1*d.* in the £ on a rating of four-fifths of his rent; (iii.) water rate, four per cent. on his rent, together with an additional sum of 15*s.* for extra service. What is his rent?

11. A French mètre = 39·371 in., and a cubic mètre of water weighs 1000 kilogrammes. Find, in inches and the decimal fraction of an inch, the side of a cubical block of granite weighing 1200·5 kilogrammes, the weight of granite being 3·5 times that of water.

12. Define Prime Factors and Least Common Multiple. Add together $\frac{7}{2431}$, $\frac{8}{2717}$, $\frac{10}{4199}$, and multiply the sum by $\cdot 46188\dot{9}$, expressing the result as a decimal.

13. A tradesman professes to retail his goods at 10 per cent. profit, but adulterates them by adding ¼th of their weight of an inferior article, which costs him ⅘ths of the price of the better. How much per cent. profit does he make? Also, in what proportion must he mix the two kinds so as to gain 20 per cent.?

14. A watch gains one minute and 12 seconds per day. It is set right at noon on the 11th of November. What will be the true time when it points to noon on the following Christmas-day?

LXXXIX.

1. Show that $\sqrt{2}$ lies between $\frac{17}{12}$ and $\frac{41}{29}$.

2. Extract the cube root of 669·921875 cubic feet, and reduce the result to inches.

*3. What is the present worth of £1842 15*s.*, payable a quarter of a year hence at 5 per cent.?

4. What length of paper 22½ inches wide would be re-

quired to paper the walls of a room 18 ft. 9 in. long, 13 ft. 3 in. broad, and 14 ft. 6 in. high?

5. Express 4 acres 2 roods 16 perches as the decimal of a square mile.

6. Multiply, by duodecimals, 7 feet 3 inches 5 parts by 5 ft. 7 in. 4 pts., and the product by 4 ft. 2 in. What does the product become when expressed in cubic feet and inches?

7. A man purchases £700 stock in the 3 per cent. Consols at 94½, and also invests £585 in the purchase of Russian 5 per cent. stock at 97½; how much stock has he standing in his name? If he sells out of the 3 per Cents at 95 and out of the 5 per Cents at 96¼, does he gain or lose by the transaction, and how much?

*8. Divide $91 \cdot \dot{8}6\dot{3}$ by $87 \cdot 5\dot{6}$.

9. A tradesman's stock in trade is valued on January 1st, 1868, at £8000, he has also £350 in cash, and owes £1870; during the year his personal expenses, £300, are paid out of the proceeds of his business, and on January 1st, 1869, his stock is valued at £7950, he has £570 in cash, and owes £1510. What is the whole profit on the year's transactions after deducting 5 per cent. interest on the capital with which he began the year?

10. A grocer buys coffee at the rate of £8 10*s*. per cwt., and chicory at £2 10*s*. per cwt., and mixes them in the proportion of 5 parts chicory to 7 coffee; at what rate must he sell the mixture so as to gain £16⅔ per cent. on his outlay?

11. Two clocks point to 2 o'clock at the same instant on the afternoon of Christmas-day; one loses 7 seconds, and the other gains 8 seconds in 24 hours; when will one be half an hour before the other, and what time will each clock then show?

12. Three sacks contain equal quantities of wheat, barley, and oats, and a mixture is formed by taking 60 per cent. from the first sack, 40 per cent. from the second, and 70 per cent. from the third; find what percentage of the whole quantity of corn is taken away.

13. If the light received by an object at different distances from a candle be inversely as the squares of the distances,

and a mirror reflect $\frac{4}{9}$ of the light which falls on it, at what distance from the candle must an object be placed in order to receive the same amount of light directly which it would receive by reflection from the mirror so placed that the whole distance traversed by the light is 5 feet?

XC.

1. Find the square root of ·000341880l and the cube root of $\frac{1}{4}$ to 5 places of decimals.

*2. Find the least number which is divisible by all the numbers up to 15 inclusive.

3. If 7 oz. of gold 22 carats fine, $12\frac{1}{2}$ oz. 21 carats fine, and 17 oz. 19 carats fine, are melted together, what is the fineness of the compound?

4. A garrison of 4500 men is provisioned for 15 weeks at the rate of 13 ounces per diem per man; how many men must leave, that the same provisions may last those who remain 27 weeks at 10 ounces per diem per man?

*5. Reduce to their simplest forms—

$$\frac{3\frac{2}{3}\times 9}{\frac{5}{6}\times\frac{7}{8}}\div\frac{\frac{1}{2}+\frac{1}{3}-\frac{9}{10}}{\frac{4}{9}-\frac{7}{18}}, \text{ and } \cfrac{1}{2+\cfrac{1}{2+\cfrac{1}{2+\frac{1}{2}}}}$$

6. What is the present worth of a bill for £694 10*s*., due $3\frac{1}{2}$ years hence, at $4\frac{1}{2}$ per cent. simple interest?

7. If $1\frac{3}{5}$ yards of cloth are worth $\frac{5}{12}$ of a bushel of corn, and 12 yards of cloth cost $4\frac{1}{2}$ dollars, what is the value of 5 quarters of corn, a dollar being equal to 4*s*. 2*d*.?

8. If a company of 160 men, in 6 days of 11 hours each, can dig a trench 230 yards long, $5\frac{1}{2}$ wide, and $1\frac{1}{2}$ deep, in how many days of 8 hours each would 96 men dig a trench 220 yards long, $3\frac{1}{2}$ wide, and 1 deep, supposing the hardness of the ground in the former case is to that of the latter as 5 to 7, and that 4 men of the latter company can do as much work as 5 of the former in the same time?

9. Two persons, A and B, hold ground in common at a rental of £54: A puts in 23 horses for 27 days, and B 21 horses for 39 days; how much of the rent should be paid by each?

10. Find by duodecimals the capacity of a tank 36 ft. 7 in. long, 7 ft. 11 in. deep, 6 ft. 10 in. wide, giving the result in cubic yards, feet, and inches.

11. A and B, working together, do a piece of work in 7 days, B alone can do it in 13 days. Suppose B works 3 days, how long will A take to finish the work?

12. A contractor agrees to sink an artesian well on the following terms: £5 per fathom for the first 30 fathoms, consisting of gravel only, £35 per fathom through the sand, £20 per fathom through clay, and £25 through chalk. He found the thickness of the chalk to be equal to half the depth of the well, and that the sand-beds were three times as thick as the clay. At the end of the work he got £2700 for his trouble. What was the depth of the well?

13. A and B, starting at opposite corners of a square whose side is 100 yards long, walk round it in the same direction: A walks 19 yards, while B walks 16. At what part of the square will they be together, and how many times will each have passed the corner from whence they started?

14. A speculator bought Spanish bonds (yielding no interest) at 18, 18 Honduras £100 bonds paying 10 per cent. interest at 35, and 27 Turkish £100 bonds paying 5 per cent. at 45. At the end of two years he sells the Honduras stock at 15, and the following year he sold the Spanish at 25, and the Turkish at 46. Including the interest, he gained £1146. What number of Spanish bonds did he buy?

15. A and B enter into business together; A gives $\frac{3}{8}$ of the capital. At the end of the first year they have made a profit of $3\frac{1}{2}$ per cent., and at the end of the second a profit of 5 per cent.; at the end of the third year they are bankrupts, and can only pay 10*s*. in the pound. The remaining money is £16663 10*s*. How much did each contribute?

XCI.

*1. Multiply 4327 by 814, and explain the process. Multiply 32856 by 121711 in three lines of multiplication only.

2. Define "Greatest Common Measure," and find the G. C. M. and L. C. M. of 157 days 7 hours 4 min. 7 sec., and 243 days 2 hours 11 min. 49 sec.

*3. Simplify $1\frac{5}{6}$ of $\dfrac{\frac{1}{2}+1\frac{1}{12}+\frac{1}{4}}{2\frac{1}{2}-3\frac{1}{3}+4\frac{1}{4}}\times\dfrac{\dfrac{2\frac{1}{2}}{3\frac{1}{7}}+\dfrac{\frac{3}{16}}{1\frac{3}{8}}}{\dfrac{3}{4\frac{1}{2}}+\dfrac{4\frac{1}{2}}{3}}$.

4. If gold is worth £3 17*s.* 10½*d.* per ounce, and silver 5*s.* 2½*d.* per ounce, how many sovereigns weigh as much as 5000 shillings?

5. A person shooting at a target distant 550 yards, hears the bullet strike the target four seconds after he fires. A spectator, equally distant from the target and the shooter, hears the shot strike the target two and a half seconds after he heard the report; find the velocity of sound.

6. Divide 8·06 by $\cdot\dot{1}80952\dot{3}$.

7. Find the length of the side of a square field containing 3952 acres 3 roods 18 perches 21½ square yards.

8. Multiply, by duodecimals, 9 ft. 7 in. 3 pts. by 2 ft. 7 in. 5 pts., and the result by 5 in. 7 pts.; what does the product become when expressed in cubic feet, cubic inches, and the fraction of a cubic inch?

9. Find the length of the edge of a cube containing 41063 cubic feet 1080 cubic inches.

10. A person buys five shares in a concern at 40, next year the price is 45, and every succeeding year there is a fall of 4. Each year he sells out 1 share, and finds at the end he has neither gained nor lost. What interest did the concern pay?

11. A person sells an article at 5 per cent. profit. If he had bought it at 5 per cent. less, and sold it for 1*s.* less, he would have gained 10 per cent. What was the cost price?

12. A person has £5000 stock in the 3 per Cents, which he invests in the 3½ per Cents at 87½, thus increasing his income by £5. Find the price of the 3 per Cents.

13. On a piece of work 2 men and 5 boys are employed, who do half of it in 6 days; after this 1 man and 1 boy more are put on, and ⅓ more is done in three days. How many more men must be put on that the whole may be completed in one day more?

14. In a mile race, A starts at 270 paces of 48 inches per minute, and B at 300 paces of 44 inches per minute; after 4 minutes, B quickens his pace to 320. Which wins, by how much, and in what time?

XCII.

1. Define the least common multiple of two or more numbers. Find the L.C.M. of 26520 and 27132, and explain the process; and add together $4\frac{217}{920}$ and $2\frac{161}{805}$.

*2. Find the square root of $99\frac{10510}{12769}$, and of ·07 to five places of decimals.

3. A legacy remains unclaimed for four years. At the end of that time it amounts to £14586 1*s.* 6*d.* at 5 per cent. compound interest. What was the original bequest?

4. Define Discount. Find the true discount on £5387 15*s.* $6\frac{1}{2}$*d.* due four years hence at $5\frac{1}{2}$ per cent. per annum.

5. Multiply, by duodecimals, 6 ft. 3 in. 8 pts. by 7 ft. 4 in. 8 pts., and the result by 8 ft. 5 in. Express the result in cubic feet, cubic inches, and fractions of a cubic inch.

6. What would £1 be worth at Paris if a bill at Amsterdam of 12 florins 15 cents sells for £1, and 9 florins 50 cents are worth 20 francs at Paris?

7. Find the length of the edge of a cube whose contents are 120066 cubic yards 10 cubic feet.

8. Find the vulgar fraction equivalent to the circulating decimal $\cdot 03\dot{2}4\dot{9}$; and, supposing it to be the fraction of a pound, express its value in pence and the fraction of a penny.

*9. A person invests £9075 in the 3 per Cents at $90\frac{3}{4}$, and when they have risen to 91 he sells out, and invests in the $3\frac{1}{2}$ per Cents at $97\frac{1}{2}$. Find the alteration in his income.

10. A prisoner of war in attempting to escape to a friendly ship, moored within sight of land, swims out at the rate of three miles per hour, and is assisted by the tide, which ebbs at the rate of 200 yards per hour. After swimming for three-quarters of an hour the tide turns and impedes him as much as it had previously assisted him. He also slackens his speed from 3 to $2\frac{1}{2}$ miles per hour, and succeeds in reaching the vessel in another hour. How far was the vessel from the shore?

11. By selling tea at 2*s.* 8*d.* per pound, a merchant gains $\frac{1}{8}$ of his outlay. He then raises the price to 3*s.* 1*d.* per pound. What does he gain per cent. on the original outlay?

12. A shilling weighs 3 dwts. 15 grains, of which 3 parts out of every 40 are alloy, and the rest pure silver. If the value of silver rises 8 per cent., what must be the reduction of pure silver in a shilling?

13. The population of a town at the census of 1861 was 55665; at the census of 1871 it was found to be 63422. The number of deaths during the 10 years was 17·7 per cent. on the population at the first census. What must have been the number of births in the period?

14. Mercury expands under heat at the rate of $\frac{1}{10000}$ of its volume for every degree (Fahrenheit) of temperature. Find the weight of a column of mercury 6 inches in height and $\frac{3}{4}$ of a square inch in section, at a temperature of 70°, assuming the weight of a cubic foot of water at 60° to be 1000 oz. Avoirdupois, and the weight of mercury at the same temperature to be 13·6 times that of water.

XCIII.

1. What decimal is equivalent to $8{\cdot}\dot{5}7142\dot{8} + 2{\cdot}30\dot{3}\dot{6} - 7{\cdot}3\dot{1}\dot{8} - {\cdot}\dot{3}$? Give the answer correct to six places of decimals.

2. Find the square of the number whose cube is 469097433.

3. Simplify

(i.) $\frac{5}{14}$ of a ton + $\frac{7}{8}$ of 2 cwt. + $\frac{13}{14}$ of a qr. + 98 lbs. − $3\frac{5}{7}$ of $2\frac{9}{13}$ of a cwt.

(ii.) $\dfrac{4{\cdot}\dot{2}8571\dot{4} \text{ of } 3{\cdot}4}{1\frac{3}{10} \text{ of } 2{\cdot}\dot{4}2857\dot{1}} \times \dfrac{{\cdot}4\dot{3} \text{ of } {\cdot}625}{{\cdot}24}$.

4. Three debts of £200, £300, £400 are due respectively in 3, 4, 5 months. If the interest is 5 per cent. per annum, what amount will pay them off at the end of 4 months?

5. A man's income is £1723 6*s.* 8*d.* He exchanges it in Paris from English to French money. When French money is at par, 1 franc = 9·4*d.*, but at the time of his exchange it is at a discount, being worth 2·2 per cent. less than when it is at par. How much did he get?

6. If an ironclad ship ordinarily cost £80000 building, $\frac{2}{5}$ as much equipping, $\frac{1}{8}$ as much storing, find the cost of 12 such vessels, supposing that 5 per cent. is saved on the cost of the building, $17\frac{1}{2}$ per cent. on fitting, and 15 per cent. on storing.

7. A person invests £2645 in railway shares at 115, the annual dividend on each share being £5. He afterwards sells out at 125, and invests in 3 per cent. Consols at 93¾. Find the change in his income.

8. A steam-engine of 4¼ horse-power, working 51 days at 6 hours a day, consumes 25 tons of coal. How much coal will be consumed by a 17 horse-power engine, working at the same work for 3 days at 8½ hours a day?

9. What sum will £668 6*s.* 8*d.* amount to at compound interest in 5 years at 11 per cent., neglecting fractions of a penny?

10. Two cogged wheels work together, there being 32 cogs on one and 36 on the other. The larger wheel makes 64 revolutions per second. How often will the same cogs come in contact during 6 working days of 10 hours each?

11. A and B run a mile race. A goes 5 feet at each step, and takes 3·3 steps per second all through the race. B goes 6 feet at each step, and takes 3 steps per second for ¾ mile; but in the last ¼ mile he only goes 5·5 feet at each step, and takes 2·5 steps per second. Which won the race, and what time did each take?

12. A plank 9 inches wide, 2 inches thick, and 8 feet long, weighs 1 oz. to the cubic inch; find the length and thickness of another plank of the same material, width, and solid content, if 2 inches cut off the end weighs 27 oz.

13. A, B, and C can do a piece of work together in 60 days. After they have worked together for 10 days A withdraws, and B and C work together at the same rate for 20 days. B then withdraws, and C completes the work in 96 days, working ⅓ longer each day. Working at his former rate C could alone do the work in 222 days. Find how long A and B would each take to do it separately.

XCIV.

1. Express in figures sixty-seven millions thirty-five thousand and twenty-four, and in words 1110011100111; also express the sum of $\frac{1}{2}+\frac{1}{6}+\cdot\dot{1}\dot{2}+\cdot 1\dot{0}\dot{1}$ as a recurring decimal.

2. Find to four places of decimals the square root of 19, and find the cube root of 206·425071.

*3. Find the Greatest Common Measure of 8214, 1110, and 1702; also find the Least Common Multiple of 11704, 101080, 138945.

4. Find the value of $\frac{3\frac{7}{8} \times 1\frac{1}{17} + 4\frac{1}{12} - 3\frac{9}{16}}{5\frac{1}{9} - 7\frac{7}{8} \div 28\frac{7}{20} + \frac{1}{3}}$, and divide ·0003 by ·0004.

*5. Which is the better investment, a stock paying $3\frac{1}{2}$ per cent. at 88, or one paying 4·4 per cent. at $96\frac{2}{3}$?

6. A clock loses 5 seconds in every 24 minutes. At 10 P.M. on Sunday it is 19 minutes fast. When will it be at the right time exactly?

7. Find the difference between the amounts produced at Compound and Simple Interest respectively by a capital of £1760 at 5 per cent. per annum for $2\frac{1}{2}$ years, the interest being payable half-yearly.

8. If 3 men working 4 hours a day can build a wall 80 feet long, 6 feet high, and 2 feet thick in 5 days, how many men working $3\frac{1}{2}$ hours a day will be required to build a wall of similar materials 100 feet long, 7 feet high, and 4 feet thick in 25 days?

9. Find (by Practice) the value of 11 tons 6 cwt. 1 qr. 19 lbs. at £4 1*s.* $10\frac{1}{2}$*d.* per ton.

*10. If the discount on a bill due five months hence at $3\frac{3}{4}$ per cent. per annum is £774 12*s.* 6*d.*, what is the amount of the bill?

11. A room is 38 ft. 3 in. long, and 25 ft. 6 in. wide. How many yards of carpet 1 yard broad will be required for the floor, if a margin of 9 inches in width is left uncarpeted all round the room?

*12. Three taps, A, B, and C, can fill a cistern, A by itself in 24 minutes, B in 10 minutes, and C in 27 minutes; they are all three turned on at once, and after running for $4\frac{1}{2}$ minutes B and C are turned off. How long will A then take by itself to complete the filling of the cistern?

13. Two trains on the same railway are running past each other in opposite directions, one 40 and the other 30 miles per hour. Each has an engine and tender; the first has 12 carriages and the second 17. If the length of an engine

and tender be 40 feet, and the length of a carriage 32, and the coupling spaces be each 5 feet, how much time will elapse from the moment that the engines meet till the last carriages of each train have passed each other?

14. A man spends a certain capital as follows: He buys 18000 acres of uncultivated land, one-third at 27*s.* an acre, one-third at 33*s.*, and one-third at 38*s.*; he has the land cleared and ploughed at 8*s.* an acre, and builds farmhouses at a cost of £6400. He then leases 16000 acres at a yearly rental of 7*s.* an acre, the farm buildings being let at the rate of 2*s.* 3*d.* per pound on their cost price; the remainder of the land he leases to a railway company at 8*s.* an acre. How much per cent. per annum does he make on the original outlay?

INDIA FOREST DEPARTMENT.

(Two and a half hours.)

XCV.

1. What would be the cost of painting the four walls of a room whose length is 24 ft. 8½ in., breadth 16 ft. 3½ in., and height 11 ft. 6 in., at 4*s.* a square foot?

2. Reduce to a simple fraction—

$$\frac{2\frac{1}{2}+1\frac{1}{4}-2\frac{1}{8}}{3\frac{3}{4}+2\frac{1}{3}-4\frac{1}{4}} \times \frac{\frac{9}{49}-\frac{4}{25}}{\frac{75}{121}-\frac{16}{27}} \div \frac{\frac{3}{7}+\frac{2}{5}}{\frac{5}{11}+\frac{4}{9}}$$

3. By selling a horse for £82 5*s.* a person lost 6¼ per cent.; how much per cent. would he have lost or gained if he had sold the horse for £90 10*s.*?

4. Find within an inch the diagonal of a square field containing two acres.

5. Multiply, by duodecimals, 10 feet 5 inches 3 parts by 9 feet 7 inches 10 parts. What does the product become when expressed in square inches and a fraction of a square inch?

6. A person invests £2500 in the 9 per cent. Japanese Loan, which was issued at 98 per cent., at 1½ discount; how much stock will he have? and what rate of interest will the investment give?

7. Find the difference between the interest and the discount on £2598 15*s.* for three years at 5 per cent. simple interest?

8. Express 4 lb. 3 oz. 12 dwts. 6 grains Troy weight as a decimal of a pound Avoirdupois.

9. Reduce $\cdot 267187\dot{5}$ to a vulgar fraction; and if the unit be £3, reduce the fraction to shillings, pence, and decimals of a penny.

10. A wall 5 times as high as it is broad, and 8 times as long as it is high, contains 18225 cubic feet. Find the breadth of the wall.

11. A person had £6900 stock, paying 3 per cent., in a company, and was offered the choice of being paid off at par, or of receiving £110 of a new 2½ per cent. stock for every £100. He chose the former alternative, and invested his money in the 3 per cent. Consols at 92. Find the amount of his stock in Consols, and the excess of his income above what it would have been if he had agreed to the proposed conversion.

12. Find the prime factors of 111540, 296352, 404352, and thence write down all the numbers which will divide them all without remainder, and the smallest number which they will all divide without remainder.

XCVI.

1. If a postage stamp be an inch long and ⅘ of an inch broad, how many stamps will be required for papering a room 18 ft. 10 in. long, 16 ft. 9 in. broad, and 9 ft. 6 in. high?

2. A man has £576 6*s.* 8*d.* per annum after paying income-tax at the rate of 4*d.* in the pound. What is his income?

3. Find the price of 3 acres 1 rood 7 perches and 88 square yards at £161 6*s.* 8*d.* per acre.

4. Find the number of yards in the side of a square park containing 439 acres 33 perches and 5¾ square yards.

5. A rectangular cistern, whose length is 13⅜ feet and breadth 6 feet, contains 294¼ cubic feet of water. What is the depth of the water? and what is its weight when a cubic inch of water weighs 252·4 grains?

6. A tenant holds a farm of 350 acres, subject to a tax of 3*s.* 6*d.* per acre, and a corn rent of 100 quarters of wheat, barley, oats, and beans respectively. Find the amount of his rent when the average prices of wheat, barley, oats, and beans per quarter are 34*s.* 9*d.*, 26*s.* 4*d.*, 17*s.* 2*d.*, and 33*s.* 10*d.* respectively.

7. Multiply, by duodecimals, 7 feet 5 inches 7 parts by 4 feet 7 inches 11 parts. What does the product become when expressed in square inches, and a fraction of a square inch?

8. Simplify $\dfrac{4\frac{1}{2}+5\frac{1}{3}+6\frac{1}{4}}{7\frac{1}{5}+8\frac{1}{6}+9\frac{1}{7}} \times \dfrac{9\frac{1}{2}+10\frac{2}{21}+11\frac{1}{24}}{1\frac{1}{4}+2\frac{1}{10}+3\frac{1}{12}}$.

9. Divide $4\cdot0\dot{3}$ by $\cdot1\dot{8}0952\dot{3}$.

10. At what rate per cent. will the true discount on £1336 11*s.* 3*d.*, due at the end of 3½ years, amount to £199 1*s.* 3*d.*?

11. If 24 pioneers, in 2 days of 12 hours long, can dig a trench 140 yards long, 4 yards wide, and 2 yards deep, in how many days of 9 hours will 180 pioneers dig a trench 4 yards wide, 3 yards deep, and 980 yards long?

12. Find the number of cubic chains and links in a rectangular parallelopiped whose edges are 189 chains, 2 chains 10 links, and 63 links.

Find the edge of the cube of equal volume with the above.

XCVII.

1. A man has £576 6*s.* 8*d.* per annum, after paying income-tax at the rate of 5*d.* in the pound. What is his income?

2. Find the square root of ·000961, and prove the correctness of the result obtained. What is the length in inches of the side of a cubical box which contains ·000027 cubic yards?

3. At what rate per cent. simple interest will 3½*d.* produce 3*s.* 6*d.* interest in 33⅓ years?

4. If a person by selling sugar at 5½*d.* per lb. loses 12 per cent., at what price per cwt. must he sell it in order to gain 8 per cent.?

5. Multiply, by duodecimals, 9 feet 7 inches 3 parts by 2 ft. 7 in. 5 pts., and the product by 4 ft. 2 in. What does the product become when expressed in cubic feet, cubic inches, and a fraction of a cubic inch?

6. How many revolutions will a carriage wheel make in a mile, the diameter of the wheel being 5 ft. 3 in., and the ratio of the circumference of a circle to the diameter being as 3·1416 is to 1?

7. Find (i.) in chains and links, (ii.) in yards and feet, the diameter of a circle which contains two acres.

8. If division by a composite number be performed by successive division by its prime factors, state the rule for finding the complete remainder. Example: Divide 1437981 by 165.

9. Find the cost of painting the four walls of a room at 8*d.* a square yard, the length of the room being 18 ft. $6\frac{3}{4}$ in., the breadth 16 ft. $5\frac{1}{4}$ in., and the height 12 ft.

10. Shares in a certain railway pay £3 5*s.* dividend per annum; how much must I give for them to get 5 per cent. for my money?

A person having bought 20 shares at this price sells them when they have risen £7 each, and buys $3\frac{1}{4}$ per cent. stock at 90. Find the change in his income.

*11. Find the Least Common Multiple of 1836, 1482, 1938, and 8398, and add together $\frac{1}{1836}$, $\frac{5}{1482}$, and $\frac{7}{1938}$.

12. If 8000 mètres be equal to 5 miles, and if a cubic fathom of water weigh 6 tons, and a cubic mètre of water 1000 kilogrammes, compare the weight of a kilogramme with that of a pound Avoirdupois.

EXCISE.

(Three hours.)

XCVIII.

1. At what rate per cent. simple interest will £900 amount to £1120 10*s.* in 7 years?

2. There are in a manufactory a certain number of workmen who receive 50*s.* a week, twice as many who receive 31*s.* 6*d.* a week, and eleven times as many who receive 14*s.* a week, and the total amount of the workmen's wages for one week is £93 9s. Find the number of workmen.

3. If a coach travels at the rate of 9½ miles per hour, and a railway train runs 25 miles while the coach is accomplishing 8 miles, how much time would a traveller save on a journey of 152 miles by adopting the train as his mode of conveyance?

4. If 200 men can make an embankment 5 miles long in 25 days, how much overtime must 60 men work in order to finish an embankment 2 miles long in 32 days, 12 hours being taken as a day's work?

5. Extract the cube root of 1194389981, and the square root of $154751\frac{77}{169}$.

6. A room three times as long as it is broad is carpeted at 4*s.* 6*d.* per square yard, and the walls are coloured at 9*d.* per square yard, the respective costs being £8 5*s.* 4½*d.* and 4 guineas. Find the dimensions of the room.

7. Divide $\cdot 3\dot{7}$ by 1·17; multiply the result by the quotient of ·052 divided by $1\cdot\dot{8}$, and give the answer in the form of a vulgar fraction.

*8. Divide £857 5*s.* 8¼*d.* among 4 persons, A, B, C, and D, so that A may have twice as much as B, B three times as much as C, and C four times as much as D.

9. Find the present value of £2674 6*s.* due at the end of 3 years at 4⅓ per cent.

10. By disposing of goods for £9 10*s*. a man loses 5 per cent. What would be his loss or gain per cent. if he had sold them for £11 17*s*. 6*d*.?

11. Find by duodecimals the cubical content of a room 14 feet 7 inches long, 12 feet 5 inches wide, and 11 feet 3 inches high. Express the answer in cubic feet and the fraction of a cubic foot.

12. The sides of a quadrilateral field ABCD are as follows: AB = 200 links; BC = 650 links; CD = 905 links; AD = 570 links, and the diagonal AC = 800 links. Find the area of the field.

13. Find within an inch the diameter of a circle whose area is 100 square yards.

14. A rectangular block of granite is 10 feet 6 inches in length, 8 feet 2 inches in width, and 4 feet in depth. Find to two places of decimals the length of the edge of a cube which has the same solid content.

15. A builder contracted to build a house in twelve weeks, and agreed to pay £5 for each day, or portion of a day, that the work remained incomplete after the end of that period. To fulfil his contract he engaged 15 men to work 10 hours a day. At the end of three weeks 10 of the men struck, and remained away from their work for a fortnight. After their return the number of working hours in the day were reduced to nine. What was due from the builder for his breach of contract?

XCIX.

1. How do you determine whether a vulgar fraction will produce a terminating decimal? Find the vulgar fraction which is equal to $\frac{\cdot 4\dot{3}4\dot{9}}{3\cdot 42\dot{5}5\dot{2}}$.

*2. Extract the square root of ·00005476 and the cube root of $2\frac{1371}{2744}$.

3. In what time will £2151 6*s*. 8*d*. amount to £2366 9*s*. 4*d*., at $2\frac{1}{2}$ per cent. simple interest?

4. Find the compound interest on £2080 for 3 years, at 4 per cent. per annum (neglecting fractions of a penny).

5. Find the present worth of £2457 12*s.* due 9 months hence, the rate of simple interest being 3½ per cent.

6. A train starts with its full complement of passengers. At the first station it drops one-third of these and takes in 96 more. At the next it drops one-half of the new total, and takes in 12 more. On reaching the third station there are found to be 248 left. What number started?

7. Find by duodecimals the volume of water which will fill a tank of which the interior is 5 ft. long, 4 ft. 7 in. wide, and 2 ft. 4½ in. deep. Express the answer in cubic feet and the fraction of a cubic foot.

8. If a man, his wife, and child consume 36 lbs. of bread in 9 days, when bread is at 5*d.* the four pound loaf, how much bread a day would a family, consisting of a man and wife and three children, have to restrict each member to so as not to exceed the same rate of expenditure when the four pound loaf costs 6*d.*? In each case assume that the rate of consumption of a man, woman, and child are as 4, 3, and 2.

9. It appeared from a daily paper that the annual expenses of the Suez Canal might be estimated at about 17800000 francs, exclusive of 10000000 francs needed for the payment of the interest on the shares. Assuming that all the receipts over and above the sum of these amounts are to be divided as profits among the shareholders, the founders, and the Egyptian Government, the holders of shares taking 70 per cent., and each of the latter parties 15 per cent., what must the yearly receipts be in order that an English holder of 20 shares out of the 400000 representing the whole stock, may receive £73 10*s.* as his proportion of the profits?

(£1 = 25 francs.)

10. The specific gravities or relative weight of proof-spirit and water may be taken as 923 and 1000, disregarding temperature. From a gallon jar filled with proof-spirit a certain quantity is drawn off and water added till the vessel is again full. The mixture is then found to have a specific gravity of 992. How much spirit has been abstracted?

11. In what proportions must wines of 15*s.*, 20*s.*, 26*s.*, and 30*s.* a gallon respectively, be mixed, so as to give a profit of 14$\frac{2}{7}$ per cent. on the cost when sold for 24*s.* a gallon?

12. A person invests £5617 10*s.* in the 3 per Cents at 93½. He sells out when they have fallen to 91¾, and invests the proceeds in Russian 5 per Cents at 98. What is the difference in his income under the two investments? Brokerage is to be reckoned at ⅛ per cent. on all the stock sold or bought.

13. The sides of a triangular field are 58, 50, and 40 chains; find its area.

14. Find the area of the largest circular plate that can be cut out of a square sheet of iron containing 25281 sq. inches.

15. The base of a rectangular prism is an equilateral triangle with a side of 7 inches, and its height is 24 inches; find its cubic content.

C.

*1. What is a recurring decimal? Illustrate your definition by writing in full the fraction which in the ordinary notation is written $1\cdot10\dot{3}\dot{1}$, and find its equivalent vulgar fraction.

2. What ready money will discharge a debt of £2113 16*s.*, due 4 months hence, at 4⅞ per cent. per annum, simple interest?

3. The annual consumption of brandy in a country is 4500000 gallons, and the duty is 9*s.* 2*d.* per gallon. The duty is reduced 6 per cent., and the consumption then increases 8 per cent. How is the revenue affected?

4. A cask weighing 2 cwt. 12 lbs. 4 oz. floats in a cubical cistern of water, whose side is 5 feet. On the removal of the cask, find how much the water will sink in the cistern, supposing a cubic foot of water to weigh 63 lbs.

5. The proprietor of a boarding school having already 30 pupils, finds that an addition of 5 increases his gross yearly expenditure by £300, but diminishes the average cost per head by £1. What did his annual expenses originally amount to?

6. Each page of a book of 560 pages contains 40 lines, and each line contains, on an average, 41 letters. How many pages will there be in another edition of the book consisting of pages of 60 lines, each line one quarter longer,

and printed in type occupying more space on the line, in the proportion of 6 to 5, than that used in the smaller edition?

7. What is meant by saying that "Railway stock is at 127½"? I invest £3103 in a company when the shares are 5½ above par, and when they are at £93 I sell out, and re-invest my capital in a company whose shares are 4½ below par; when these last shares are 1 above par I sell out. What money have I gained or lost?

8. In what proportion must a grocer mix black tea at 2*s.* 4*d.* a pound with green tea at 3*s.* 8*d.*, so as to sell the mixture at 2*s.* 8*d.* a pound?

9. Multiply, by duodecimals, 5 ft. 6 in. by 3 ft. 4 in., and the product by 2 ft. 3 in. Give the result in cubic feet and inches.

10. In Fahrenheit's thermometer the freezing-point is 32°, and the boiling-point 212°; in Reaumur's and the Centigrade thermometers the freezing-point is 0°, and the boiling-point 80° and 100° respectively. When the Centigrade stands at 5° below zero, where will (i.) the Fahrenheit and (ii.) Reaumur's stand?

11. One kilogramme = 10 hectogrammes = 100 décagrammes = 1000 grammes. Find the value of 47 kilogr. 8 décagr. 4 gr. of an article, the price of which is £23·57 a kilogramme, giving the answer in pounds, shillings, and pence.

12. Two clocks strike 9 together on Monday morning. On Tuesday morning one wants 8 minutes to 11 when the other strikes 11. How much must the slower be put on, that they may strike 9 together in the evening?

13. One vessel contains 24 gallons of water; another contains 12 gallons of wine. One gallon is taken from each, and is then poured into the other. This is done three times. How much wine and how much water will the vessels then respectively contain?

14. What is the area of the largest circle that can be inscribed in the square whose area is 5499025 square feet? What is the length of its circumference?

15. Write down the volume of a circular cone in terms of the height and the area of the base.

What is the volume of the largest cone that can be cut out of the cube whose volume is equal to that of the rectangular solid whose edges are respectively 368, 1012, and 2783 feet?

CI.

1. An estate is divided among three persons A, B, C, so that A has $\frac{5}{8}$ of the whole, and B has twice as much as C. It is found that B has 27 acres more than C. How large is the estate?

2. If 2 cwt. 1 qr. 3 lbs. of an article is bought for 15*s*., and 17 lbs. is sold for 1*s*. 3*d*. What profit is made per cent.?

3. What fraction of 300 yards is 1 furlong 2 poles 6 yards 2 feet? Express the answer as a decimal.

Express as a fraction of an acre the ground taken up by a path 3 feet broad round a house, the front of which is 57 feet and side 37 feet long.

4. Extract the square root of $30789\frac{268}{289}$, and the cube root of 2326203·125.

5. How many ounces of silver are there in a piece of plate costing £59 10*s*., the price of silver being ·255 of £1 per ounce, and the cost of manufacture $\frac{1}{6}$ the value of the silver used.

6. Explain what is meant by the Least Common Multiple of two or more numbers.

Find the Least Common Multiple of 3696, 286, and 19656.

7. Find the value of $1{\cdot}7\dot{2}$ of $\cdot\dot{2}7\dot{6}$ of 15.

8. How much must a man invest in the $3\frac{1}{2}$ per Cents. at 91 in order to receive £590 per annum after paying 4*d*. in the pound income-tax?

9. The difference between the discount and interest on a debt due a year and a quarter hence at 4 per cent. is 5*s*. What is the debt?

10. A tradesman's prices are 12 per cent. above cost price. If he allows £1 6*s*. 3*d*. discount on a bill of £21, what profit does he make per cent.?

11. A man rents a house from the first of January at £142 per annum, payable half-yearly. He sublets it for £160 per annum, payable quarterly. Allowing simple interest at 4 per cent., what will he make by the transaction in 3 years?

12. A cistern containing 600 gallons measures externally 7 feet in length, 2 feet 11 inches in breadth, and 5 feet 6 inches in height. The sides being $1\frac{1}{2}$ inches thick, what is the thickness of the bottom?

(A cubic foot of water contains $6\frac{1}{4}$ gallons).

13. The map of a country is drawn on the scale of $\frac{1}{10}$ of an inch to a mile. What area on the map will represent a lake 4000 acres in extent?

14. A fast train leaves a place A, for another place B, at the same moment that a slow train leaves B for A. The fast train takes 2 hours on the journey, and if the slow train kept its time they would meet at a distance from B equal to $\frac{3}{8}$ the whole distance from A to B. Instead of this the place where they meet is at a distance from B equal to $\frac{1}{4}$ the distance from A to B. How much behind time will the slow train be when it arrives at A?

15. A round column stands on a cubic pedestal of the same material, whose edge is six feet. The column is hollow, the external and internal diameters measuring five feet and four feet respectively. If the weight of the column be the same as that of the pedestal, what is its height?

CII.

1. Find the square root of $8636\frac{136}{225}$, and the cube root of ·000017576.

2. Find the value of $\cdot\dot{6}\dot{5}$ of $4\cdot\dot{1}\dot{1}$ of $\frac{3\frac{2}{3}}{13}$ of $2\cdot\dot{4}3\dot{2}$ of 13*s.* 6*d.*

3. Multiply, by duodecimals, 13 feet 6 inches 7 parts by 8 ft. 3 in. 3 pts., and the product by 4 ft. 5 in. What does the product become when expressed in cubic feet, cubic inches, and the fraction of a cubic inch?

4. A rectangular grass-plot, the sides of which are as 2 : 3, costs £14 8*s.* for turfing, at the rate of 4*d.* per square yard; find the length of its sides.

5. Transform 30763451 into the duodenary scale.

6. A and B buy cigars at £2 1*s.* 8*d.* per hundred. A sells them at 6*d.* each, while B sells them in bundles of 25 for 12*s.* Compare their gain per cent.

7. At what time between 12 and 1 o'clock are the hands of a clock exactly opposite to each other?

8. A man estimates his expenses as follows: Rent of house, one-tenth of income; expenses of living, 80 per cent. of remainder. He finds he will then save £126 per annum; what was his total income?

9. What is the true discount on £1380 7*s.* 6*d.*, due nine months hence, at 3 per cent. per annum?

10. Which is the better investment, the $3\frac{1}{2}$ per Cents at 91, or the 4 per Cents at 112; and what is the difference per cent. between them?

11. Find the area of a triangle whose sides are 45·6 yards, 70·2 yards, and 140·4 feet.

12. Find the number of square inches in the surface of a glass shade in the shape of a cylinder, with a hemispherical top, the diameter of the shade being 12 inches, and the total height to the top of the dome 2 feet.

13. Find the number of cubic feet of stone in Cleopatra's needle, taking the form of the obelisk as the frustum or portion of a square pyramid, 61 ft. high, 7 ft. 8 in. square at the base, and 4 ft. 6 in. square at the top, and capped at the top by a square pyramid 7 ft. 6 in. from the base to the apex.

14. The mean temperature from the 9th to the 15th January, 1877, both included, was $36^\circ\cdot6$, and from the 10th to the 16th it was $39^\circ\cdot9$; the mean temperature on the 9th was $30^\circ\cdot5$; what was it on the 16th?

15. Two pumps, discharging respectively 80 and 100 gallons per minute, are employed to drain a well. It is observed that if the smaller pump only is at work, the water sinks one inch per minute; and if both are employed from the first, the well is pumped dry in two hours. Find its depth.

CIII.

1. Find the square root of 144·600625, and the cube root of $3460\frac{41}{512}$.

2. Reduce $\cdot\dot{4}\dot{5}$ of $2\cdot1\dot{6}$ of 2*s.* 6*d.* to the fraction of $\cdot\dot{0}2\dot{7}$ of $1\cdot\dot{1}\dot{8}$ of £5.

3. Multiply 79 ft. $7\frac{1}{2}$ in. by $69\frac{3}{4}$ in., and express the result in square rods and the fraction of a rod.

4. The dimensions of a rectangular box are as 2 : 3 : 4, and the difference between the cost of covering it with sheet-lead at 8*d.* and $8\frac{1}{2}$*d.* a square foot is 4*s.* $10\frac{1}{2}$*d.* What are the dimensions of the box?

5. Reduce to the decimal of a cubic yard the volume which is expressed in the duodenary scale by 1*t*538 cubic inches.

6. A merchant buys wine at £47 5*s.* a hogshead, and offers it for sale at 40*s.* per dozen. If he allows 5 per cent. discount for cash payment, what profit per cent. will he make on his outlay?

7. Two men run a 3-mile race round a course of $\frac{3}{10}$ of a mile. If their rates are as 4 : 3, how often and where does the winner pass the other?

8. Of the inhabitants of a district devastated by war 60 per cent. were slain, $\frac{5}{8}$ of the remainder perished in flight, and 200 alone survived. What was the population of the district?

9. Find the value on March 1st of the expectation of a sum of £3724 10*s.* 5*d.*, due November 30th the same year, the rate of interest being 5 per cent.

10. What income will be obtained by investing £2849 in 3 per cent. stock at $92\frac{1}{2}$? What sum invested would produce the same income when the price of the stock is 91?

11. Find the area of a quadrilateral figure in which one of the diagonals is 93 feet, and the perpendiculars upon it from the opposite angles are 60·5 feet and 36·7 feet respectively.

12. What quantity of metal will be required to make a hollow spherical ball, the external diameter being 18 inches, and the thickness $4\frac{1}{2}$ inches?

13. Find the area of the surface of a frustum of a cone, the diameters of the ends being $2\frac{1}{2}$ feet and $1\frac{1}{4}$ feet, and the height 5 feet.

14. In Fahrenheit's thermometer the freezing-point is marked 32°, and the boiling-point 212°; and in the Centigrade thermometer the freezing-point is 0°, and the boiling-point 100°. When the temperature, according to Fahrenheit, is 65°, what is it by the Centigrade?

15. The pressure of compressed air varies inversely as its volume. If the pressure on the inner surface of a cylinder, fitted with a piston, be 20 lbs. on the square inch, and when the piston is forced in 2 inches the pressure becomes 30 lbs. on the square inch, what is the length of the cylinder?

AVERAGES AND PERCENTAGES.

(Two hours).

CIV.

1. Find the average of $13\frac{12}{25}$, 21, $7\frac{3}{4}$, ·0023, $3\frac{1}{8}$, 0, $106\frac{1}{2}$, and $57\frac{7}{20}$. Express the fractional part decimally.

2. If by selling wine at 15*s.* per gallon I lose 6 per cent., at what price must I sell it to gain $17\frac{1}{2}$ per cent.?

3. Of 32 selected candidates for the East Indian Civil Service in 1859, 3 were above 20 years of age when they went to India, 4 above 21, 12 above 22 and 23 respectively, and 1 above 24. From these data find what is the average age at which the men went to India.

4. A merchant has teas worth 4*s.* 6*d.* and 3*s.* 6*d.* per lb. respectively, which he mixes in the proportion of 3 lbs. of the former to 2 of the latter, and sells the mixture at 4*s.* 4*d.* per lb. What does he gain or lose per cent.?

5. Between the years 1841 and 1851 the population of England increased 14·2 per cent. In the latter year it was 21121290. What was it in the former year?

6. A person invests £5460 in the Three per Cents at 91; he sells out £2000 stock when they have risen to $93\frac{1}{2}$, and the remainder when they have fallen to 85; he then invests the produce in the Four-and-a-half per Cents at 102. What is the difference in his income?

7. What must be the market value of 6 per cent. stock in order that, after deducting the income-tax of 10*d.* in the £, it may yield $6\frac{1}{2}$ per cent. interest?

8. Reduce $\dfrac{5\cdot1183}{\cdot00705}$ of $11\cdot\dot{1}$ of $\cdot2\dot{9}$ of $\cdot11\dot{7}$ to a vulgar fraction.

CV.

1. The population of five parishes being 1236, 452, 364, 516, and 3430 respectively, find what the population of a sixth parish must be in order that the average population of the six may be 1256·5.

2. A person has ⅕ of a ship, worth £3484, which is insured for 91⅔ per cent. of its real value; what would he lose in case of the ship being lost?

3. The populations of 3 towns in the year 1841 were 21326, 42324, and 6706; and in the year 1851 it was found that the first two had increased 12 and 10 per cent. respectively, and the last decreased 18 per cent.; find the average population of the three towns in the year 1851.

4. If a person sells 22 articles for the same money which he paid for 36, what does he gain per cent. on his outlay?

5. By selling tea at 5*s.* 4*d.* a pound, a grocer clears one-eighth of his outlay; he then raises the price to 6*s.* 2*d.*; what does he clear per cent. upon his outlay at the latter price?

6. A person sells out of the Three per Cents at 96, and invests his money in railway 5 per cent. stock at £106 13*s.* 4*d.*; find how much per cent. his income is increased.

7. Having given the following table—

Length of Railway in England in 1849.	Number of		
	First-class Passengers.	Second-class Passengers.	Third-class Passengers.
Miles. 4355·5	6186899	18844152	24848313

find (i.) the average number per mile of each class, (ii.) the percentage proportion of each of the three classes.

ASSISTANT-CLERKSHIP, R.N.

(Three hours.)

CVI.

1. Reduce twenty-nine million six thousand five hundred and three inches to miles, furlongs, &c.

How many seconds are there in 49 weeks 4 days 13 hours 9 minutes? Express your answer in words.

2. Find (by Practice) the value of 15 tons 19 cwt. 3 qrs. 16 lbs. at £2 12*s.* 6*d.* per cwt.

3. What will be the dividend on £2738 16*s.* 8*d.* at 9*s.* 4½*d.* in the pound?

4. If 15 men, 12 women, and 9 boys can complete a piece of work in 50 days, what time would 9 men, 15 women, and 18 boys take to do 4 times as much, the parts done by each in the same time being as the numbers 3, 2, and 1?

5. Simplify $\frac{1\frac{5}{7}+\frac{11}{4}-3\frac{7}{12}}{2\frac{10}{21}-1\frac{5}{6}+\frac{7}{8}}$ of $1\frac{107}{148}$.

6. Reduce $\frac{17}{125}$ to a decimal, and divide the difference between this decimal and 3·236 by the sum of ·002 and ·0005.

7. Find the value of $\frac{\cdot\dot{0}\dot{4}}{\cdot\dot{7}6923\dot{0}}$ of $\frac{91\cdot\dot{1}6\dot{5}}{5\cdot\dot{0}9\dot{7}}$, expressing the result both as a vulgar fraction and as a decimal.

8. Reduce $\frac{3}{7}$ of £1 to the fraction of $1\frac{1}{3}$ of £3 5*s.*

Find the value of $\frac{4}{7}$ of a cwt. + $8\frac{5}{8}$ lbs. + $3\frac{9}{10}$ oz.

9. Express the difference between $\frac{3}{8}$ of a guinea and $\frac{7}{9}$ of £1 as the decimal of half-a-guinea.

Add together ·7 of 8 furlongs and 19·627 of 4 furlongs.

10. What is the income corresponding to the income-tax of £58 1*s.* 4½*d.* at 4*d.* in the pound?

*11. Find the difference between the simple and compound interest of £365 4*s.* 8¼*d.* for 3 years at 4 per cent.

12. What principal in 3 years 73 days will amount to £10 1*s.* 10½*d.*, interest at 6¼ per cent.?

13. Goods are marked at the credit price of 3*s.* 8*d.*, allowing 9 months' credit. What should they be sold at for ready money, discount at 4½ per cent.?

14. When £100 stock may be purchased in the Three per Cents for £89½, at what rate may the same quantity of stock be purchased in the Three-and-a-half per Cents with equal advantage?

15. A and B each invest a certain sum of money in a business. The sum which A invests is ⅔ of that which B invests. At the end of 7 months A withdraws ¼ of his capital, and at the end of 9 months B withdraws ¼ of his. The profits at the end of the year are £132 12*s.* How ought this sum to be divided?

16. A merchant in London is indebted to one at St. Petersburg 15000 roubles; the exchange between St. Petersburg and England is 50*d.* per rouble, between St. Petersburg and Amsterdam 91*d.* per rouble, and between Amsterdam and London 36*s.* 3*d.* per £ sterling. What difference will it make if the London merchant is drawn upon through Amsterdam instead of direct?

17. If 17 men can build a wall 22 yards long, 5 feet high, and 1 foot wide in 9 days, working 11 hours a day, in how many days can 51 men build a wall 60 yards long, 7 feet high, and 2 feet wide, working 12 hours a day?

18. I gave 8*s.* for a basket of oranges and lemons, buying the former at the rate of 2 for 3*d.*, and the latter at 5 for 4*d.* I then sold all at the uniform rate of 5 for 6*d.*, and gained 6¼*d.* per cent. How many had I of each kind?

19. What will be the cost of carpeting a room 9·75 yards long and 4⅙ yards wide with carpet 1 yard 3 inches wide, at 4*s.* 6*d.* per yard?

CVII.

1. Reduce five million four hundred and ninety-six pounds eighteen shillings and sixpence three farthings to farthings, and express the result in words.

2. Find (by Practice) the value of 45 cwt. 3 qrs. 21 lbs. at £1 6*s.* 8½*d.* per cwt.

3. If £500 amounts to £780 in $13\frac{3}{17}$ years, what rate of interest (simple) has been received for it?

4. For what sum should a building worth £2460 be insured, at £3 4*s.* 6*d.* per cent., so that the owner in case of loss may receive the value of the building and the premium?

5. Find the least sum of money which can be paid in pence, shillings, florins, half-crowns, crowns, half-guineas, sovereigns, and guineas.

6. Coal is bought at 24*s.* per ton, and sold at 25*s.* 6d.; how many tons must be sold per year to realize an income of £350?

7. If a boat can be built by 5 men in 15 days, working 12 hours per day, how many hours per day must 7 men work to build $\frac{5}{8}$ of it in 9 days?

8. The value of $\frac{1\frac{2}{8}}{4\cdot25}$ of $\frac{2}{5}$ of a vessel is £100; what proportion does a person own who sells $\frac{3}{11}$ of $\frac{2}{9}$ of his share for £$\frac{400}{33}$?

9. Simplify the expression—

$$\frac{\frac{5}{14}-\frac{3}{7}\text{ of }\frac{1}{2}}{\frac{5}{16}+\frac{7}{12}\text{ of }3\frac{1}{4}-(\frac{7}{8}\text{ of }\frac{37}{21}-\frac{1}{3})}\div\frac{\frac{1}{3}\text{ of }\frac{1}{2}+\frac{3}{2}\text{ of }5}{9\frac{1}{3}-1\frac{2}{3}}.$$

10. Reduce 2 miles 7 furlongs 18 perches 3 yards to the decimal of 1 league.

11. A person sells out of the Three per Cents at 96, and invests his money in railway 5 per cent. stock at £106 13*s.* 4*d.*; by how much per cent. is his income increased?

12. Find the value of $5\cdot634\times\cdot0057+\frac{4\cdot2325}{8465}\div\frac{\cdot39424}{5632}$.

13. What in French money is the value of £1 sterling when the value of the franc in English money is 9·386*d.*?

14. A bankrupt has good debts to the amount of £456 18*s.* 1*d.*, and the following bad debts: £360 7*s.* 10*d.*, £120 13*s.*, and £19 18*s.*, for which he receives respectively 4, 5, and 9 shillings in the pound. What do his liabilities amount to if he is enabled to pay 3*s.* 4*d.* in the pound?

15. If an ounce of gold be worth £$4\cdot\dot{0}09\dot{9}$, what is the value of a bar of gold weighing $1\cdot68\dot{3}$ lbs.?

*16. A person in London wishes to remit a debt of 1016 pistoles to Madrid when the exchanges are 1 Spanish pistole = 15*s.*, £1 = 25·4 francs, 19 francs = 1 Spanish pistole. Is it more advantageous to remit directly to Madrid, or circuitously through Paris?

17. The radius of a wheel is 3 feet; how many revolutions does the wheel make in a mile, considering the ratio of the diameter of a circle to its circumference to be 1 : 3·1416?

*18. The sum of £434 is due as follows: $\frac{1}{3}$ of it in 4 months, $\frac{1}{2}$ of it in 5 months, and the remainder in 7 months. Find the equated time for one payment of £434 according to mercantile discount.

19. Suppose that 15 men would be necessary to excavate 966 cubic yards in 8 days of 10$\frac{1}{2}$ hours each, how many men did a contractor engage for 12 days of 7$\frac{1}{2}$ hours to excavate 575 cubic yards, if he found it requisite to engage 4 additional men during the last four days in order to complete the work in 12 days?

20. How many flag-stones, each 5·76 feet long, and 4·15 feet wide, are required for paving a cloister which encloses a rectangular court 45·77 yards long and 41·93 yards wide, the cloister being 12·45 feet wide?

21. Find the respective times between 4 and 5 o'clock, when the hour and minute hands of a clock are (i.) exactly opposite each other, (ii.) at right angles to each other, (iii.) coincident.

CVIII.

1. How many seconds are there in 64 years? Express the result in words.

2. A gentleman gives a gold snuff-box, weighing 11 oz. 19 dwt. 16 grains, valued at £4 3*s.* 9*d.* an ounce, in part payment for 24 silver plates, each weighing 7 oz. 11 dwts. 6 grs., valued at 6*s.* 8*d.* an ounce, what sum of money will he have to pay in order to discharge the bill? (To be done by Practice.)

3. I invest £1270 in Three per Cents at 92$\frac{1}{2}$, and selling out, after allowing the interest to accumulate for two years, I find myself richer by £147 10*s.*; at what price did I sell out?

4. A mètre being 39·371 English inches, what is the value in mètres of 4 miles 6 furlongs 11 poles? Express also as the fraction of a mètre, the length of a seconds pendulum (39·1393 inches).

5. A room is 24 feet long, 13$\frac{1}{2}$ wide, and 9$\frac{1}{2}$ high; the

ceiling is whitewashed at *7d.* the dozen square yards; the walls are papered at $\frac{3}{4}$*d.* the square foot (deducting 16 per cent. for windows, doors, &c.), and the floor is carpeted at 3*s.* 7*d.* the square yard. Find the whole cost.

6. If the 4*d.* loaf weighs 3·35 lbs. when wheat is 4·75*s.* a bushel, what ought to be the price of wheat per bushel when 47·5 lbs. of bread cost 13·3*s.*?

7. A contractor agrees to execute a certain piece of work in a certain time; he employs 55 men who work 9 hours daily; when three-fourths of the time is expired he finds that only three-sevenths of the work is done. How many men must he employ during the remaining part of the time, working 11 hours daily, in order that he may fulfil his contract?

8. A man bought 296 sheep at £1 7*s.* 6*d.* each, and after paying $\frac{2}{11}$ of his outlay for their keep, exchanges them for 37 cows, which he then sold at £15 per head. What did he gain per cent. on his expenditure?

*9. From a bill of £3 11*s.* 8*d.*, due 18 months hence, a tradesman deducts 5*s.*; what is the rate per cent. at which the true discount is calculated?

10. A person has an income of £350 from money invested in the New Three per Cents; he sells out at 87$\frac{5}{8}$, and invests in the India Five per Cents at 104$\frac{3}{4}$. How will his income be affected, $\frac{1}{8}$ per cent. being allowed for brokerage?

11. Simplify $\frac{2}{5}$ of $\frac{13}{16} - \frac{1\frac{2}{3}}{6\frac{2}{3}}$ of $\frac{19}{20} + \frac{3}{7}$ of $\frac{6\frac{5}{12}}{3\frac{2}{3}}$.

12. In a cricket match a side of 11 men made a certain number of runs, one obtained $\frac{1}{8}$ of the number, each of two others $\frac{1}{10}$, and each of three others $\frac{1}{20}$, the rest made up between them 126, which was the remainder of the score, and four of these last scored five times as many as the other. What was the whole number of runs?

13. Find the length of the side of a square whose area is 9659664 square yards.

14. If the exchange between London and Amsterdam be 36*s.* Flemish per pound sterling, and between Paris and Amsterdam 2 francs per 3*s.* Flemish, how much money sterling must be remitted to Paris, by way of Amsterdam, to

discharge a debt of 20000 francs? Find also the arbitrated value between London and Paris.

15. Divide £5678 15*s.* 9*d.* among three persons in the ratios of $2\frac{1}{2}$, $3\frac{1}{3}$, $4\frac{1}{4}$.

16. If 1 lb. of sugar cost ·0703125 of 16*s.*, what is the value of ·0625 cwt.?

17. A bill bought in London at 25·6 francs per £ sterling is sold in Lisbon at 172 reis per franc. What is the exchange between London and Lisbon?

18. Find the value of $\cdot\dot{2}8571\dot{4}$ of £30 + £$6\cdot\dot{8}5714\dot{2}$ + 5·8 of £$2\cdot411458\dot{3}$.

19. What principal will produce an interest of £270 6*s.* 8*d.* in $4\frac{1}{2}$ years at $3\frac{1}{2}$ per cent. per annum?

20. If 8000 mètres be equal to 5 miles, and if a cubic fathom of water weigh 6 tons, and a cubic mètre of water 1000 kilogrammes, find the ratio of a kilogramme to a pound Avoirdupois.

(Two and three-quarter hours).

CIX.

1. If gunpowder be composed of 15 parts of nitre, 3 parts of charcoal, and 2 of sulphur, how much of each of these ingredients is required to make $12\frac{3}{4}$ cwt. of powder?

2. When is a fraction said to be in its lowest terms?

*Reduce to its lowest terms the fraction $\frac{8996427}{9078399}$.

3. Simplify the expression $\dfrac{9\frac{1}{4} - 2\frac{7}{10}}{2\frac{3}{4} + 3\frac{4}{5}}$.

4. Distinguish between a vulgar and a decimal fraction.

Divide $\dfrac{48\frac{4}{7}}{1085\frac{7}{10}}$ by $\dfrac{7\frac{3}{11}}{174\frac{3}{17}}$, and express the quotient in a decimal form.

5. Add together ·00125 ton, ·0125 cwt., and ·075 lb.

6. Extract the square root of $4\frac{213}{289}$.

7. A sum of money was left for division among 56 persons, subject to a tax of 10*d.* in the pound. The deduction caused by the tax amounted to £21 17*s.* 6*d.* How much did each receive?

8. A man owns $\frac{3}{17}$ of a mine, and sells $\cdot4\dot{7}$ of his share; what portion of the mine does he then retain?

9. At what rate per cent. will £1200 amount to £1436 10*s.* in 3 years and 7 months at simple interest?

10. A rectangular fireplace, 1 ft. 4 in. broad, 1 ft. 8 in. high, and 10 in. deep, consumes its own volume of coal in 1·4 hours. Find the weight of the coal consumed in 8½ hours, if a cubic foot of coal weighs 82·5 lbs.

11. A wine merchant buys 6 dozen of wine at 72*s.* per dozen, and 20 dozen more at 54*s.* per dozen. What is his gain per cent. if he sells the mixture at 63*s.* per dozen?

12. One company pays 5½ per cent. on shares of £100 each; another pays at the rate of 3½ per cent. on shares of £10 each. If the price of the former be £115 10*s.*, and of the latter £7 15*s.*, compare the rates of interest which the shares return to purchasers.

CX.

1. A collection amounting to £153 10*s.* 10*d.* consisted of an equal number of half-crowns, florins, shillings, and pence. How many were there of each kind of coin?

2. Find the L.C.M. of the numbers 508 and 889.

3. Express in its simplest form $\frac{2\frac{1}{3}+5\frac{1}{2}}{2\frac{1}{5}-1\frac{1}{6}}+\frac{2\frac{1}{9}+3\frac{1}{7}\text{ of }1\frac{3}{11}}{4\frac{1}{5}\text{ of }3\frac{4}{7}-1\frac{2}{9}}$.

*4. Add together $7·07\dot{6}$, $19·\dot{2}4\dot{5}$, and $18·2\dot{0}\dot{3}$.

5. Divide ·0043007450 by ·5326, and express the quotient as a vulgar fraction in its lowest terms?

6. Extract the square root of 1383542416.

7. If 15 cwt. 1 qr. 12 lbs. of rice cost £24 15*s.* 6*d.*, what should be paid for 2 tons 7 cwt. 8 lbs.?

8. How many revolutions will be made by a wheel which revolves at the rate of 151 revolutions in 3 minutes, while another wheel revolving 241 times in 7 minutes makes 723 revolutions?

9. Find the amount of £1256 10*s.* lent for 2 years at 3½ per cent., compound interest.

10. Three persons, A, B, and C, join in business. A invests £500 for 3 months, B £650 for 8 months, and C £300 for 11 months; they gain £420. Find the share of each.

11. A room is 14½ feet long, 12¾ feet broad, and 8¼ feet

high. Required the cost of papering its walls at the rate of $2\frac{3}{4}$*d.* per square foot.

12. A man has £2500 stock in the Three per Cents, which he sells, and invests the proceeds in the Four per Cents at 105. If the increase in his income be £12, find the price at which he sold the 3 per cent. stock.

CXI.

*1. If 13 solid inches of copper balance 17 of iron, and 15 of iron balance 16 of tin, and 19 of tin balance 12 of zinc, how many solid inches of zinc balance 1235 inches of copper?

2. Express in its lowest terms the difference between $\frac{2}{153}$ and $\frac{8}{207}$.

3. Divide $\frac{41\frac{3}{7}}{1192\frac{7}{9}}$ by $\frac{10\frac{6}{11}}{165\frac{2}{13}}$, and reduce the quotient to a decimal.

4. Find the value of $\cdot\dot{7}\dot{2}$ of $\cdot 20\dot{1}\dot{8}$ of 3 miles 4 furlongs 24 poles.

5. Divide ·0003568 by 111·5.

6. If 5 qr. 3 bus. 1 pk. of corn cost £9 17*s.* 6*d.*, find the price of 1 qr. 7 bus. 3 pk.

7. A roller 4·12 feet in circumference and 2·45 feet in width, makes 35 revolutions in passing from one extremity of a lawn to the other. Find the area rolled when the roller has passed 42 times the length of the lawn.

8. What sum of money must be lent at $2\frac{1}{2}$ per cent. simple interest for $5\frac{1}{4}$ years so that at the end of that time it may amount to £814 10*s.*?

9. A dealer purchasing spirit at 5 shillings per gallon, dilutes it with so much water that, selling it at 4*s.* 6*d.* per gallon, he gains 20 per cent. upon his outlay. How much water is there in every gallon of the compound?

10. If a cubic foot contains 343 cubic units, how many square units are there in a rectangle, whose sides are 147 feet and 40 feet respectively?

11. The difference between the incomes derived from investing a certain sum in 4 per cent. stock at $112\frac{1}{2}$ and in $2\frac{1}{2}$ per cent. at 75 is £84. Find the sum invested.

(Half an hour).

CXII.

(1)

3205679
21223
2567
854698
21222
7192834
1019
887246
29995
355782
2122887
82176

(2)

3234698
21229
818295
2122
8684779
21197
11298
9497863
22219
23467722
1299557
21228

(3)

£	s.	d.
84321	12	6½
278569	18	4¾
8432956	0	0¾
9199	19	10¼
25565	17	8
7218659	13	0½
9273	4	7¼
98397	18	4½
87629	13	11
9199	17	10¾
734698	11	8½
3312	8	4
81659	7	4½
214932	5	8
796	12	11¼
84	7	6
314785	19	2½
27746	5	8¾
217532	8	11½
3456	7	9¾
99987	6	11
345	9	8½
2494	7	10
24269	8	11¾
3565	15	7½
352362	13	6
7797	17	7½
88559	11	10
6592	17	8¼
33	8	7½

(4)

£	s.	d.
890567	13	7¾
21735	18	9½
8296	12	8¾
745689	8	3½
94329	17	9
33445	0	8¾
2224	12	11
101	13	4½
77159	8	7½
8246	12	8¾
349	8	6½
95699	10	11¼

(5)

£	s.	d.
71564	12	8⅕
218	4	$7\frac{3}{10}$
8185	19	3⅛
212	9	4¼
8497	0	7
109	14	5½
78	12	6
95946	8	4⅜
819	19	0½
2122	7	8¾
844	0	0½
67291	8	9⅗

CXIII.

(1)

1564321
28345728
99472
213569
854
71865297
828893
22456
8779651
829948
8286954
778856

(2)

9256894
82569
317986
2122
869
53721
895687
41458
2196995
83818
219769
82156

(3)

£	s.	d.
2954321	8	7½
96123	15	7¼
81725631	4	8
229979	12	8½
7716	5	6
279	8	11¾
727986	15	4
21229	18	5½
7788	5	4¾
87	12	8
321946	7	2
8857	8	3½
21225	17	4¾
4477	8	1
212256	12	7¼
77156	13	3
2956	19	4½
21225	7	10¼
861334	12	9
2244	5	7¾
99176	8	3
1246	7	2
75	8	6¾
98765	13	8½
221	17	4
33987	5	6½
224	11	8
925678	13	7¼
296	8	11
82884	17	7¾

(4)

days.	hours.	min.	sec.
91	16	48	43
543	12	27	29
29	13	14	17
89	17	18	29
199	20	35	37
666	12	18	42
977	17	14	36
21	20	37	25
296	18	42	51
667	21	46	21
29	18	17	40
12	19	36	50

(5)

£	s.	d.
2196532	12	2½
2124	17	8⅜
229	5	6¼
8269	7	8 3/16
21725	8	3½
922	17	8⅛
77865	13	3¼
2122	9	7¾
822	7	8½
212469	12	7
8188	9	11⅝
876	8	4½

CXIV.

(1)

1967832
214298
36571
216
98725683
500721
21469
8887712
99211
2774
821965
2277899
81432

(2)

21778921
84655
7277
921855
2317789
6653
92189
821669
12888
9765
8287931
212234

(3)

£	s.	d.
2653478	12	$2\frac{1}{2}$
21986	13	5
278	9	$8\frac{1}{2}$
771659	3	$4\frac{3}{4}$
2186	12	$7\frac{1}{2}$
92165	17	$11\frac{1}{4}$
721	8	$4\frac{3}{4}$
82885	9	11
9987	8	$3\frac{1}{2}$
212986	5	$9\frac{3}{4}$
2199	12	7
8432	8	$4\frac{1}{2}$
217	9	7
4566	19	$11\frac{3}{4}$
91223	4	$8\frac{1}{2}$
21	9	7
8456	11	$8\frac{3}{4}$
217799	8	$5\frac{3}{4}$
1214	19	$8\frac{1}{2}$
299	8	$7\frac{3}{4}$
8184	16	$9\frac{1}{2}$
217	12	8
49972	15	$6\frac{1}{4}$
2356	8	$7\frac{3}{4}$
145689	13	0
81823	4	$9\frac{1}{2}$
2122	12	$2\frac{3}{4}$
12869	8	7
432	13	$4\frac{1}{2}$
81882	17	8

(4)

£	s.	d.
21224	5	9
369	8	$6\frac{1}{2}$
474482	13	$4\frac{3}{4}$
8899	19	$11\frac{1}{2}$
21865	8	$7\frac{1}{4}$
9989	12	$8\frac{3}{4}$
771	16	$5\frac{1}{4}$
8821	19	$8\frac{3}{4}$
12769	14	$5\frac{1}{2}$
881	12	0
52691	13	4
7785	9	$6\frac{3}{4}$

(5)

£	s.	d.
219699	5	$8\frac{3}{8}$
2142	13	$4\frac{1}{2}$
46982	17	$5\frac{3}{4}$
821	6	$8\frac{5}{12}$
8789	13	$2\frac{1}{2}$
99861	7	$10\frac{1}{8}$
246	5	$8\frac{3}{4}$
828199	7	$11\frac{1}{12}$
1283	13	6
452	11	$8\frac{3}{4}$
21225	17	$4\frac{1}{2}$
4698	12	$11\frac{7}{8}$

ROYAL COLLEGE OF SURGEONS.

PRELIMINARY EXAMINATION.

CXV.

1. What number must be added to 57464 to make it exactly divisible by 429?

2. Multiply £74 17*s.* $8\frac{1}{2}$*d.* by 297; and divide £824 1*s.* $10\frac{3}{4}$*d.* by 59.

3. Find the cost of $5367\frac{1}{2}$ pints at 4*s.* 6*d.* per gallon.

4. Add together $2\frac{3}{5}$, $3\frac{8}{25}$, $7\frac{13}{125}$; and from $13\frac{4}{195}$ take $8\frac{37}{234}$.

5. Simplify $2\frac{7}{9} \times 7\frac{1}{5} \times \frac{3}{8}$ and $13\frac{2}{225} \div 8\frac{4}{15}$.

6. Express $2\frac{17}{625}$ as a decimal, and 1·071875 as a vulgar fraction in its lowest terms.

7. Divide 1·87 by ·0763 to two places of decimals.

8. A tank holds 5360 gallons of water; find the weight of the water (in tons, &c.), knowing that a gallon of water weighs 10 lbs.

9. Sea-water contains $2\frac{1}{2}$ per cent. of salt; how much sea-water would be required to obtain half a ton of salt?

CXVI.

1. Add together—

acres.	roods.	poles.	sq. yds.
41	2	17	14
27	1	31	27
53	3	23	18

and subtract from their sum 22 acres 35 poles.

2. The following quantities of five different drugs are mixed in the concoction of a gross of medicinal draughts; viz.,

oz.	drms.	scr.	gr.
2	3	0	17
4	7	2	5
7	5	1	14
1	4	2	18
5	1	1	0

Determine the weight of mixed-drugs in each draught.

3. Multiply 81 hhds. 2 kild. 17 gals. by 86; and divide the result by 27.

4. Find the difference of cost of coal during the half-year from Michaelmas to Lady-day (26 weeks), on account of a rise in price from 21*s.* 6*d.* to 37*s.* a ton, to a person who burns on an average $12\frac{1}{2}$ cwt. a week.

5. Find the value of

(i.) $2\frac{1}{2}+3\frac{1}{3}+4\frac{1}{4}+5\frac{1}{5}$. (ii.) $6\frac{1}{3}$ of $4\frac{1}{2}-2\frac{1}{4}$ of 3.

(iii.) $\dfrac{7\frac{1}{9} \text{ of } 5\frac{3}{8}+2}{3\frac{1}{7} \text{ of } 2\frac{4}{11}-1}$.

6. Find the value of

* (i.) $\frac{7}{11}$ of £2 6*s.* 9*d.* (ii.) $6\frac{4}{9}$ of £723 4*s.* 10*d.*,

and reduce 1*s.* $8\frac{1}{2}$*d.* to the fraction of £1.

7. Reduce $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{8}$ of £1 to the decimal of £5 12*s.* 6*d.* Multiply ·714825 by ·013, and give the result in the form of a vulgar fraction in its lowest terms.

8. A and B ride a bicycle race, the former maintaining an average speed of 14 miles an hour through the whole distance of 240 miles. B has an accident, which delays him half an hour, and causes that, when A reaches the journey's end, he is 27 miles off. Determine B's average speed.

CXVII.

1. If 81 oxen can be purchased for £1779 4*s.* $3\frac{3}{4}$*d.*, what is the value of one?

2. Add together the following quantities, and divide their sum by 7:

oz.	dram.	scr.
11	7	2
4	3	2
10	5	0
9	4	1

3. Find the value of $3\frac{3}{8}+2\frac{5}{6}+\frac{7}{12}+3\frac{4}{9}$.

4. Reduce $4\frac{1}{5}$ of £2 13*s.* $7\frac{3}{4}$*d.* to the fraction of £2 14*s.* $8\frac{1}{4}$*d.*

5. Divide $\dfrac{7\left(1\frac{1}{2} \text{ of } \frac{3}{14}\right)}{\frac{1}{6}\left(\frac{3}{3\frac{1}{2}} \text{ of } 7\right)}$ by $\dfrac{9}{14}$.

6. Find the value of (i.) $\cdot 0032 \times 23\cdot 45$, (ii.) $181\cdot 3 \div \cdot 00037$.

7. Find the difference between 1·6 of 3·4 of £1·125 and $\frac{1}{5}$ of $3\cdot\dot{6}$ of £9·1125.

8. Express in Troy weight the difference between $\frac{3}{8}$ lb. Troy and $\frac{3}{8}$ lb. Avoirdupois.

CXVIII.

1. Add together—

lbs.	oz.	drams.	scr.	grains.
5	10	7	2	19
18	5	2	0	12
25	10	4	1	8
20	9	3	2	15

2. Multiply £250 13*s.* 4*d.* by 66, and divide the product by 55.

3. 126 sheep are bought for £409 10*s.* and sold for £488 5*s.*; what is the profit on each sheep?

4. Find the value of $15\frac{7}{8} + 3\frac{4}{9}$ of $5\frac{7}{31} - 32\frac{15}{16}$.

5. Divide $7\frac{5}{19}$ by $4\frac{74}{361}$.

*6. Reduce £7 18*s.* $8\frac{1}{2}$*d.* to the fraction of £27 15*s.* $5\frac{3}{4}$*d.* in its lowest terms.

7. Find the values of ·0056 × 2·625 and ·057 ÷ 22·8.

8. Find the value of 1·000125 of £1000.

9. If a pound Troy of arrowroot cost 5*d.*, what is the cost of 720 lbs. Avoirdupois at the same rate?

CXIX.

1. Multiply 5 oz. 7 drs. 2 scr. 15 grs. by 35; and divide £29 11*s.* $4\frac{1}{2}$*d.* by 83.

2. Determine the least number by which 272 must be multiplied to produce a number exactly divisible by 238.

3. Find the difference between the average length of a month in the first and second halves of the year 1880.

4. Add together $\frac{17}{105}$, $5\frac{2}{7}$, $\frac{5}{11}$ of $3\frac{13}{25}$; and from $112\frac{3}{14}$ take $8\frac{11}{12}$.

5. Express $\frac{13}{1000}$, $\frac{3}{8}$, $\frac{41}{110}$ as decimals; and ·07625 as a vulgar fraction in its lowest terms.

6. Simplify— (i.) 1·375 + 30·2 + ·07125.
(ii.) 1·5 × ·025 × 10·08.
(iii.) ·0738 ÷ 3·28.

7. What part of £6 1*s.* $1\frac{3}{4}$*d.* is $\frac{5}{6}$ of £3 12*s.* $8\frac{1}{4}$*d.*?

8. Find the value of £1·69375, ·5625 oz., and ·3875 of 15*s.*

9. Express 758 millimètres in inches.

CXX.

1. Multiply seven millions seven thousand and seven by nine thousand and ninety.

2. Multiply £12 10*s.* $6\frac{1}{2}$*d.* by 1296.

3. How many times can a sum of £12 15*s.* 6*d.* be paid out of £1022?

4. Multiply 10 cwt. 2 qrs. 12 lbs. by $3\frac{1}{5}$.

5. Reduce to one fraction $\frac{1}{3}+\frac{2}{27}+\frac{3}{81}+\frac{4}{243}+\frac{5}{729}$.

6. Divide ·025 by 1·25, and 3·24 by 180.

7. Find the value of 1·25 of 50*s.* + 2·05 of 18*d.* + 1·5 of £5.

8. If 20 lbs. of coffee cost 35*s.*, what would 4 cwt. 2 qrs. 16 lbs. cost?

9. If I buy 10 horses for £300, and 12 cows for £120, and resell the former at £35 each, and the latter at £12 each, what profit do I make per cent. on my outlay? What must I sell the whole at to gain 30 per cent.?

CLERKSHIPS IN THE BANK OF ENGLAND.

CXXI.

1. Write down in figures eighty millions sixty thousand and two.

2. Write down and add up the following amounts:

£	s.	d.
691040	3	7
6781	2	2
15691	13	9
37	9	1
63177	2	5
129374	15	7
836	2	7
1047	13	9
74321	18	9
4785	13	11
38839	7	1
227	18	4

3. Multiply £1024 3*s.* 7*d.* by 360.

4. Add together $1\frac{7}{8}$, $\frac{5}{9}$, $3\frac{1}{7}$, and $4\frac{1}{5}$.

5. Divide $9\frac{1}{11}$ by $\frac{7}{10}$.

6. Express 25 minutes 15 seconds as the decimal fraction of an hour.

7. Find (by Practice) the cost of a silver cup weighing 10 oz. 7 dwts. 12 grains at 11*s.* an ounce.

8. Divide 27·25 by ·007 to three places of decimals.

9. A bankrupt pays $3\frac{1}{2}$*d.* in the £, and the total of his payments amounts to £154, what was his debt?

10. At what rate per cent. will £1 become a guinea in 5 years, simple interest?

11. The length of a street is 937 feet 6 inches, and its breadth 66 feet 8 inches; find the cost of paving it at $8\frac{1}{2}$*d.* per square yard.

12. Find the least common multiple of 64, 720, and 960.

13. Two persons gained in trade £375; one having put in £500, and the other £850; what part of the profit ought each person to receive?

14. How many francs must be transmitted from Paris to Berlin to discharge a debt of 420 thalers, a thaler being equivalent to 3*s.*, and 24 francs to one pound sterling?

15. What ought to be the value of £135 in the Four-and-a-half per Cents when the Three per Cents are at 97⅛?

16. A cistern is filled by two pipes in 20 and 24 minutes respectively; and it can be emptied by a tap in 30 minutes; what part of it will be filled in 15 minutes when all the taps are left open together?

CXXII.

1. Express in figures thirty millions one thousand and three.

2. Write down and add up the following amounts:

£	*s.*	*d.*
278604	12	9
17384	6	2
8706	4	9
12309	13	7
125207	8	6
7	2	9
1684	5	7
128	13	6
27168	5	8
2764	18	7
194	7	5
18	13	3

3. Multiply £1084 7*s.* 6*d.* by 672.

4. Add together ½, ⅓, ¼, and ⅕.

5. Divide 8·16 by ·004.

6. Which is the greater, ⅓ of 4, or ¼ of 5? and by how much?

7. Reduce 5 lbs. 11 oz. 2 dwts. 17 grains to grains.

8. Divide 15⅜ by 2¼.

9. At what rate per cent. will £500 amount to £625 in three years, simple interest?

10. A person fails to the amount of £9000, and his effects are worth only £3515 12*s.* 6*d.*; what will be the dividend in the pound?

11. What would be the difference in income made by the transfer of £5000 stock from the Three per Cents at 72 to the Four per Cents at 90?

12. The standard silver coin of this realm is made of 37 parts of pure silver and 3 parts of copper, and a pound Troy of this metal yields 66 shillings. What weight of pure silver is there in 20*s.*?

13. If I lose 1¼*d.* in 3*s.* 4*d.*, how much do I lose per cent.?

14. Find the square root of 8244·64.

15. What is the expense of carpeting a room 28 feet long and 19 feet wide with carpet ¾ yard wide, at 5*s.* 9*d.* per yard?

16. A general levied a contribution of £870 on four villages containing 250, 300, 400, and 500 inhabitants respectively; what must each village pay?

EXAMINATION FOR ADMISSION TO THE STAFF COLLEGE.

CXXIII.

1. If sixteen shillings is the profit in making a thousand bricks, what is the profit in making sixty million of bricks?

2. Find the value of 15 bushels of corn at $1\frac{1}{2}$*d.* the pint.

3. If silver plate weighing 3 lbs. 4 oz. 7 dwts. 8 grs. is valued at £20 3*s.* 8*d.*, what is the price per ounce?

4. In six days 24 horses eat food costing £7 12*s.* How many horses can be kept 9 days on food costing £11 8*s.* at the same rate of consumption?

5. Multiply $\frac{3}{8}+1\frac{1}{16}-\frac{1}{2}$ by $4\frac{2}{5}-3\frac{2}{15}+\frac{7}{10}$, expressing the product as a decimal.

6. Reduce $\frac{\cdot 01314}{\cdot 001533}$ to a vulgar fraction in its lowest terms.

7. Find the number of feet in 35·33 furlongs.

8. Divide 3·1 by ·0005.

9. Express $4\frac{1}{2}$*d.* as the decimal of 13*s.* 9*d.*

10. Merchandize weighs 4 tons 4 cwt. 1 lb. after being reduced in weight 3 per cent. by waste. What was the weight originally?

11. What is the sum to be paid to discharge a debt of £550 6*s.* 8*d.* due 14 months hence, when discount at 5 per is allowed?

12. Extract the square root of 253009, and that of the recurring decimal ·0126126126...to four places of decimals.

CXXIV.

1. A gentleman distributed £166 7*s.* 6*d.* in equal portions among 121 poor people. How many half-crowns did each receive?

2. A bankrupt who can only pay 7*s.* 1*d.* in the pound, owes a creditor £563 10*s.* What will that creditor receive?

3. If 15 pumps working 8 hours a day can raise 1260 tons of water in 7 days, in how many days will 30 pumps working 12 hours a day raise 7560 tons of water?

4. Find the cost of paving a floor whose length is 33 feet 2 inches and breadth 18 feet at 6*s.* per square yard.

5. A contractor agrees to supply sugar at 9*d.* per lb.; he buys the sugar at 70*s.* per cwt. What will he gain per cent.?

6. Reduce to its lowest terms $\frac{2910}{6499}$, and find the value of $\frac{2910}{6499}$ of £134.

7. What fraction of an angle of a regular pentagon is an angle of an equiangular triangle?

8. Express as a finite decimal $5\frac{5}{640} + \cdot 75$ of $\frac{6}{5}$ of $7\frac{1}{2}$, and find its money value, supposing it to be the decimal of £1000.

9. The driving wheel of a locomotive, 5 feet in diameter, turned 5000 times in going 12 miles. Supposing the circumference of a circle to be 3·1416 times the diameter, find what distance in miles was lost owing to the slipping of the wheel on the rail.

10. When a fraction in its lowest terms is reduced to a decimal, show that if the decimal is not finite it must recur; and examine the limit of the number of digits in the recurring period for a given denominator of the fraction.

Express the recurring period of $\frac{6}{7}$, and find the equivalent vulgar fraction for $\cdot 78\dot{5}1\dot{6}$.

11. Find the value of $\frac{(12\cdot 5)^2}{(\cdot 005)^3}$.

Extract the square root of 13 to four places of decimals.

12. A square field contains 40 acres. What is the length of a side of the field?

CXXV.

1. Find the cost of 1 ton 17 lbs. 5 oz. at the rate of £22 8*s.* the cwt.

2. If $256\frac{1}{2}$ pounds of tea cost £53 8*s.* 9*d.*, what is the price of a pound?

3. If 11 horses eat 30 bushels of corn in 13 days, how many horses can be fed at the same rate of consumption on $67\frac{1}{2}$ quarters of corn for 78 days?

4. To what amount will a debt of £35 12*s.* 6*d.* be reduced after 12 per cent. has been deducted from it?

5. Find the number of square feet in $\frac{5}{8}$ of $3\frac{3}{11}$ of an acre.

6. What is the average annual profit of a business when a partner entitled to $\frac{2}{7}$ of the profits receives as his share for two years and four months the sum of £3598 13*s.* 5*d.*?

7. Multiply 350·4 by ·0105, and divide the product by ·0000219.

8. Express 7 furlongs as the decimal of 1 mile 480 yards.

9. Convert the recurring decimal ·3545454... into a vulgar fraction, and find the weight of silver of which this decimal part is 3 lbs. 3 oz. 1 dwt. 19 grains.

10. At what rate of simple interest will £39 3*s.* 4*d.* amount in 3 years to £43 1*s.* 8*d.*?

11. Extract the square root of 226576, and also that of $2352\frac{1}{4}$.

CXXVI.

1. Find the cost of 87 articles at 2*s.* 5*d.* each.

2. If 97 lbs. of coffee cost £14 2s. 11*d.*, what will 73 lbs. cost at the same rate?

3. A piece of gold, at £4 10*s.* the ounce Troy, is worth £37 2*s.* 6*d.* What is the weight in grains of a piece of silver of the same value at 6*s.* the ounce?

4. Reduce to its lowest terms the vulgar fraction $\frac{1044}{1080}$, and then convert it into a recurring decimal.

5. Prove that $11{\cdot}45-\frac{11}{12}=10\frac{8}{15}$. If the unit be 2 acres 1 rood, how many perches does $10\frac{8}{15}$ represent?

6. Multiply 13750 by ·001824.

7. Divide ·0089 by the recurring decimal ·267267.....

8. If income-tax is levied at the rate of £2 14*s.* 2*d.* on £100, what income will a person have left who has paid £24 7*s.* 6*d.* as his income-tax?

9. Find the amount of £586 13*s.* 4*d.* after it has been placed for $2\frac{1}{2}$ years at $4\frac{7}{8}$ per cent., simple interest.

10. Find the square root of 41·7316, also that of $\frac{38642}{31752}$.

11. A railway company pays in the course of 8 years a yearly dividend of £3·8125 per cent. The dividend declared in the first seven years being $3\frac{1}{2}$, $3\frac{1}{4}$, $3\frac{1}{2}$, 4, $4\frac{1}{2}$, $4\frac{1}{4}$, 4 per cent., what was the dividend in the eighth year?

CXXVII.

1. The sum of £399 2*s.* 6*d.* is distributed as prize-money to a number of soldiers; they each received £3 17*s.* 6*d.* How many soldiers were there?

2. Calculate the duty on 40 cwt. 2 qrs. 24 lbs. of coffee at $6\frac{1}{10}$*d.* per lb.

3. If 153 gas-lights, burning for 12 hours, consume 4800 cubic feet of gas, how many lights, burning for 9 hours, consume 6000 cubic feet of gas at the same rate?

4. If the adjacent sides of a rectangle be 5 and 3 feet respectively, show that the area of the rectangle may be represented by the product of these numbers.

Find the cost of carpeting a room 48 ft. 9 in. long by 20 ft. 3 in. wide at 3*s.* 4*d.* a square yard.

5. A person invests £2400 in the Three per Cents when they are at $88\frac{7}{8}$; what income will he derive, and what rate of interest does he receive for his money?

6. Standard silver contains 37 parts in 40 of fine silver, and one pound Troy of standard silver is coined into 66 shillings. Calculate the value of the money which can be coined from 222 lbs. Avoirdupois of standard silver, it being given that 144 lbs. Avoirdupois are equal in weight to 175 lbs. Troy.

7. Examine the rule for reducing a compound fraction to a simple one. Express as a single fraction—

$$\tfrac{13}{15} \text{ of } 3\tfrac{3}{4} + \tfrac{11}{16} \text{ of } 9\tfrac{3}{5} - \tfrac{1}{5} \text{ of } 2\tfrac{3}{4} - 1\tfrac{7}{8}.$$

8. Multiply 47·035 by ·0064, and divide 75·337 by 121·75. Verify the last result by vulgar fractions.

9. The length of a seconds' pendulum is 39·37079 inches; if 64 mètres French are equal to 70 yards, by what decimal of an inch will the length of a seconds' pendulum differ from one mètre?

10. If a vulgar fraction in its lowest terms have a denominator 12, show that the fraction cannot be expressed by a finite decimal. Find the value of $2\cdot\dot{5}0\dot{4}$ of £4 2*s.* 6*d.*

11. Divide $(\cdot01)^3$ by $(\cdot05)^4$. Extract the square root of 7 to four places of decimals, and express the true value of the remainder that appears in the operation after the four places have been obtained.

12. The sum of £5000 is invested for 4 years at 5 per cent.; find how many years must £4500 be invested at 3 per cent. so that the simple interest in both cases may be the same.

CXXVIII.

1. What is the value of 1 ton 2 cwt. of sugar at 3½*d.* the pound?

2. Find the cost of papering a room 10 feet long, 17 feet wide, and 10 feet high, with paper 15 inches broad, at 3¾*d.* the yard, making no deductions for windows or doors.

3. Add together ⅜ of a guinea, $\frac{3}{16}$ of a crown, and ⅗ of 3*s.* 9*d.* Reduce the result to the decimal of £1 12*s.*

4. How many grains are there in $\frac{3}{7}$ of 1 lb. 5 oz. 3 dwt. 14 grains Troy?

5. Divide 756·45246 by ·00615.

6. Find the number of square yards in ·3 of 1 acre 3 roods.

7. In what time will £256 6*s.* 8*d.* amount to £352 9*s.* 2*d.*, at 7½ per cent. per annum, simple interest?

8. Extract the square root of 542 to three places of decimals.

EXAMINATION FOR NAVAL CADETSHIPS.

(Two and a quarter hours.)

CXXIX.

1. At the Mint 2500 coins can be struck off at one press in an hour; supposing four presses at work, coining respectively half-crowns, shillings, pence, and farthings, what would be the whole sum coined in a day of 12 working hours?

2. A plate of gold cost £161 17*s.* 6*d.*, at £4 7*s.* 6*d.* per ounce. What was its weight?

3. In 100 half-guineas how many fourpenny pieces? How many acres, &c., are there in one million square inches?

4. If 2 cwt. 1 lb. cost £116 19*s.* $0\frac{3}{4}$*d.*, what is the cost of one pound?

5. How many yards of carpet 25 inches wide will it take to cover a floor that is 19 ft. 7 in. long by 18 ft. 9 in. wide?

6. Find (by Practice) the value of 333 articles at £5 18*s.* $11\frac{1}{2}$*d.* each.

7. A steamer traverses the measured (nautical) mile in 3 min. 50 sec; find her speed per hour in statute miles. (N.B.—The nautical mile is 6072 feet in length.)

8. From $5\frac{1}{3}$ of $4\frac{1}{2}$ deduct $3\frac{1}{4}$ of $3\frac{1}{5}$.

9. Divide $16\frac{2}{3}$ by $12\frac{1}{2}$.

10. Reduce $5\frac{3}{16}$ and $\frac{69}{22}$ to decimals.

11. Divide 1708·4592 by ·00024.

12. Reduce $1\frac{1}{4}$ of £3·675 to the decimal of 10*s.* 6*d.*

CXXX.

1. Multiply 4 tons 15 cwt. 2 qrs. 27 lbs. by 195.

2. Reduce 760215 inches to miles.

3. How much water must be added to a cask containing 70 gallons of spirits, worth 13*s.* 4*d.* a gallon, to reduce the price to 11*s.* 8*d.* a gallon?

4. A person's income is £420 a year, and his average daily expenditure is £1 1*s.* $3\frac{1}{2}$*d.* How much will he save in 4 years (including one leap-year)?

5. The telegraph posts on a railway are 66 yards apart, and a train was observed to pass from one to another in 3 seconds. Find the speed of the train (in miles) per hour.

6. What will be the expense of carpeting a room 23 ft. 9 in. long and 16 ft. 3 in. wide at 2*s.* 9*d.* per square yard?

7. Add together $\frac{5}{7}$, $\frac{1}{2}$, $2\frac{1}{6}$, and $\frac{3}{28}$ of $3\frac{1}{3}$.

8. Find the value of $\frac{7}{16}$ of £7 5*s.* + $\frac{1}{8}$ guinea − $\frac{3}{8}$ of 5 shillings.

9. Reduce 7*s.* $10\frac{1}{2}$*d.* to the decimal of a guinea.

10. Find the value of ·046875 cwt.

11. Divide 27·5264 by ·00374.

12. Reduce $\cdot4\dot{2}\dot{9}$ and ·0375 to vulgar fractions in their lowest terms.

CXXXI.

1. Write down in figures fifty-four thousand and forty-nine million six hundred thousand and fifteen, and in words 50603003401.

2. Reduce £15 19*s.* 8*d.* to farthings; 4 lbs. 5 oz. 15 dwt. to grains; and 1935360 oz. Avoirdupois to tons.

3. Find the Greatest Common Measure of 16650, 10730, and 1961.

4. The sum of £8485 was left by will to be divided equally among a certain number of persons. The share of each amounted to £565 13*s.* 4*d.*; find the number of persons.

5. Reduce to their Least Common Denominator the fractions $\frac{5}{27}$, $\frac{24}{81}$, $\frac{7}{18}$, $\frac{2}{9}$, $\frac{105}{567}$.

6. Find the value of $3\frac{2}{5} \times \dfrac{7\frac{1}{7} \text{ of } 1\frac{2}{5}}{3\frac{1}{5}}$.

7. Express $2\frac{2}{5}$ of £15 16*s.* 3*d.* as the fraction of £50 4*s.* 9*d.*

8. Multiply 65·54335 by 2·035, and divide the product by ·01310867.

9. Express $\frac{109}{20000}$, $\frac{51}{495}$ as decimals, and reduce ·00525, $\cdot0\dot{7}\dot{3}$ to vulgar fractions in their lowest terms.

10. Find (by Practice) the value of 3 cwt. 16 lbs. 10 oz. of sugar at £3 16*s.* 4*d.* per cwt.

11. What is the cost of papering a square room 22 ft. 6 in. in length and 12 ft. 4 in. in height with paper 2 ft. 4 in. wide at 9*d.* per yard?

12. If a train, which travels at the rate of $35\frac{1}{2}$ miles an hour, performs a certain journey in 11 hours 45 minutes, in what time would a train do it travelling $42\frac{3}{4}$ miles an hour?

CXXXII.

1. Write down in figures, twenty thousand seven hundred and nine million fifteen hundred and one; and in words, 600075080705.

2. Reduce 27045 guineas to half-crowns; 5 bushels 2 pecks 3 quarts to pints; 560872 cubic inches to cubic yards.

3. What is meant by the Least Common Multiple of two or more numbers? Find the L.C.M. of 153, 204, and 221.

4. Divide 606 tons 1 cwt. 2 qrs. 27 lbs. by 145.

5. Find the value of $\frac{132}{169} - \frac{14}{65} + \frac{35}{91} + \frac{7}{39} - \frac{21}{52}$.

6. Simplify the fraction $\dfrac{7\frac{1}{2} \times \frac{1}{5} \text{ of } \frac{4}{9}}{13\frac{5}{12} - 12\frac{7}{9}}$.

7. Reduce 5*s.* $4\frac{1}{2}$*d.* to the decimal of £1 7*s.* 6*d.*

8. Express the fractions $\frac{1}{7}$, $\frac{11}{21}$, and $\frac{9}{925}$ as decimals, and ·1634, $\cdot\dot{5}9\dot{1}$, $\cdot 9\dot{7}\dot{2}$ as vulgar fractions in their lowest terms.

9. Multiply 526·32 by ·0573, and divide the product by ·0072.

10. Find the value of ·75 of 6*s.* 8*d.* − 1·84375 of 4*s.* + 3·9796 of 2*s.* 6*d.*

11. What length of matting, $\frac{3}{4}$ yard wide, will be required to cover a room 39 ft. 6 in. long by 25 ft. 6 in. wide? Find its cost at 4*s.* 6*d.* per yard.

12. If 3 cwt. 1 qr. 15 lbs. of sugar cost £10 17*s.* 6*d.*, find the cost of 7 cwt. 3 qrs. 12 lbs.

CXXXIII.

1. What number divided by 48762 will give 6285 for a quotient and 26108 for a remainder?

2. How many dollars are there in £289 17*s.*, at 4*s.* 3*d.* per dollar?

3. A stationer buys 36 reams of paper at 16*s.* 6*d.* per ream, and 84 reams at 17*s.* 9*d.* per ream. Find his entire outlay.

4. If 2 cwt. 1 lb. cost £116 19*s.* $0\frac{3}{4}$*d.*, what is the cost of 1 lb.?

5. An equal number of men, women, and boys, earned £8 5*s.* in 6 days; each man earned 1*s.* 4*d.*, each woman 10*d.*, and each boy 4*d.* a day. How many were there of each?

6. If the duty on hops at $1\frac{1}{2}$*d.* per lb. amounts to £26357 9*s.* $10\frac{1}{2}$*d.*, on what quantity is it paid?

7. (i.) What will 1 ton 11 cwt. 2 qrs. 14 lbs. cost at £1 13*s.* 7*d.* per cwt.? (ii.) Extract the square root of 22071204.

8. In what time will 25 men do a piece of work which 12 men can do in 15 days?

9. (i.) From $\frac{2}{5}+\frac{5}{6}$ take $\frac{3}{8}+\frac{7}{12}$. (ii.) Find the value of $\frac{3}{7}$ of $1\frac{2}{3}$ of $12\frac{1}{2}$ of $\frac{3}{20}$. (iii.) Reduce $\frac{4}{7}$ lb. to the fraction of a cwt.

10. (i.) Divide ·0068 by 340, and 314 by ·0005. (ii.) Extract the square root of 3·026. (iii.) Reduce 16 cwt. 1 qr. 21 lbs. to the decimal of a ton.

11. I bought 40 oxen for £500, and sold 12 at a loss of 3 per cent. How must I sell the rest per head so as to be free from loss on the whole?

12. Five hundred boys are distributed in 3 houses; the smallest house contains $\frac{7}{25}$ of the whole number, and the largest contains $\frac{19}{14}$ of the smallest. What is the number in each?

13. Standard gold is formed by mixing 11 parts of fine gold with one part of copper. How many sovereigns will be coined from 4 oz. Avoirdupois of fine gold when 1 lb. Troy of standard gold is coined into $46\frac{29}{40}$ sovereigns?

CXXXIV.

1. The moon's distance from the earth is 240000 miles, and the sun's is 95000000 miles; how much further is the sun from the earth than the moon is?

2. Reduce 540697 inches to miles, furlongs, &c., and multiply 15 lbs. 9 oz. 17 dwts. 18 grs. by 23.

3. If 4 cwt. 1 qr. 26 lbs. of tobacco cost £43 18*s.* 6*d.*, what quantity can be purchased for £4 19*s.* 9*d.*?

4. What quantity of silver can be bought for £36, when 14 lbs. 6 oz. 15 dwts. cost £45?

5. A person's income is £598 10*s.*, his weekly expenses are £7 10*s.*, and he gives away annually £20 in charity; how much will he have remaining?

6. When coals cost 11*s.* 6*d.* a ton, what will be the annual expense of fuel for an engine whose daily consumption averages $2\frac{1}{2}$ tons?

7. How many days of 15 hours each would 60 men take to perform a piece of work, if 45 men can do it in 30 days of 12 hours each?

8. If 1 lb. Troy of gold be coined into £46 14*s.* 6*d.*, what is the weight of a sovereign?

9. (i.) Reduce $\frac{6409}{7395}$ to its lowest terms; (ii.) from $10\frac{2}{21}$ take $7\frac{5}{14}$; (iii.) multiply together $\frac{5}{6}$, $\frac{9}{10}$, and $2\frac{2}{3}$.

10. (i.) Multiply 7·51 by ·703; (ii.) divide 201·4095 by ·703; (iii.) reduce $100\frac{4}{125}$ to a decimal.

11. How many square feet of glass are required to glaze 5 windows, each containing 14 panes of glass, each measuring 18 inches by 6 inches?

12. A man mixes 20 gallons of ale, which cost him 16*d.* a gallon, with 65 gallons of beer, which cost him 9*d.* a gallon; at what price must he sell the mixture to gain 20 per cent.?

CXXXV.

1. Multiply 3 tons 15 cwt. 1 qr. 16 lbs. by 154.

2. Reduce 68435 florins to half-crowns; 7 ounces 15 dwts. 12 grains to grains; 96543 square inches to square yards.

3. How many plots of ground, each containing 1 rood 24 poles, are there in a field, the area of which is half a square mile?

4. Find the G.C.M. of 2697, 3441, and 1271.

5. Simplify $\frac{3}{4}+\frac{2}{3}+\frac{7}{12}+\frac{5}{96}+\frac{13}{100}$, and subtract the result from $3\frac{1}{6}$.

6. Find the value of ($\frac{2}{3}$ of $\frac{7}{8}+\frac{3}{7}$ of $\frac{14}{15}$) of 3*s.* 4*d.*

7. Reduce $\frac{1}{3}$ of $\frac{5}{8}$ of $1\frac{9}{10}$ of half-a-sovereign to the decimal of a guinea.

8. Divide ·00176963 by 2·71, and ·7 by $\cdot6\dot{3}\dot{6}$.

9. Find (by Practice) the value of 5 cwt. 3 qrs. 16 lbs. 12 oz. of sugar at 5*s.* 6*d.* per quarter.

10. If the wages of 14 men for a month be £143 10*s.*, how many men must work for the same time to receive £174 5*s.*?

11. How many planks $15\frac{1}{4}$ ft. long and $1\frac{1}{4}$ ft. wide will be required to floor a room 60 ft. long by $30\frac{1}{2}$ ft. broad?

12. A man saves $\frac{1}{8}$ of his income, gives away $\frac{1}{16}$ of it in charity, and spends the remainder, £520. Find the amount of his income.

CXXXVI.

1. Write down in figures two hundred and eleven thousand two hundred and four million seven hundred and sixty-five thousand twelve hundred and six.

2. Multiply £1267 4*s.* 2*d.* by 335.

3. Reduce 27 acres 2 roods 17 poles to poles, and 1899520 oz. to tons.

4. Reduce to its lowest terms $\frac{4266}{5451}$.

5. Find the value of $\dfrac{1\frac{2}{9} \text{ of } 3\frac{9}{10}}{\frac{13}{27}} \div \dfrac{1}{\frac{5}{11}}$.

6. An estate is worth £8000, and a person entitled to $\frac{3}{8}$ of it sells $\frac{5}{32}$ of his share. Find the value of the remainder of his share.

7. Subtract $4\cdot3\dot{5}\dot{4}$ from $5\cdot\dot{8}69\dot{3}$, and divide ·067206 by 24·35.

8. Add together $\frac{3}{16}$ of 2*s.* 6*d.* and $\frac{17}{42}$ of a guinea, and from the sum deduct $3\frac{7}{12}$ of 1*s.* 6*d.*

9. Express $\frac{11}{27}$ of 10*s.* 6*d.* as the decimal of £5 5*s.*

10. Find (by Practice) the value of 125 yds. 3 qrs. 2 nls. of cloth at 4*s.* 6*d.* per quarter.

11. If 8 miles 2 furlongs of railway cost £165028 12*s.* 6*d.*, find the cost of laying down 22 miles 7 furlongs.

12. A room is 16 feet in length, 8 feet 4 inches in breadth, and 7 feet 6 inches high. Required the expense of painting the four walls at $4\frac{3}{4}$*d.* per square foot.

CXXXVII.

1. Write down in words the difference between twenty-three thousand and five million two hundred and sixty-nine thousand eight hundred and seven, and ten million seventeen thousand and one.

2. Reduce 7 cwt. 1 qr. 16 lbs. 8 oz. to drams, and 12896 pints to bushels.

3. The circumference of a carriage-wheel is 2 yds. 2 ft. 2 in.; how many times will it revolve on a journey of 27 miles 551 yds. 2 ft. 2 in.?

4. Reduce to its lowest terms the fraction $\frac{46878}{67913}$.

5. Simplify the fractions $\dfrac{2}{1+\dfrac{3}{3+\frac{3}{2}}}$, $\dfrac{4\frac{2}{9} \text{ of } \frac{3}{17}}{2\frac{7}{9}+5\frac{2}{3}}$.

6. Express $2\frac{2}{3}$ of $1\frac{5}{16}d.$ as the fraction of 2*s.* 6*d.*, and find the value of $2\frac{3}{5}$ of £1 7*s.* 6*d.*

7. Multiply 5·27 by 3·45, and divide ·1040864 by 3·52.

8. Find the value of ·5275 of £1 5*s.* + ·245 of half-a-crown − ·095 of half-a-guinea.

9. Find (by Practice) the value of 15 yds. 2 ft. 8 in. of carpet at 5*s.* 4*d.* per yard.

10. If the rent of 19 acres 3 roods 20 poles be £39 18*s.*, what should be the rent of 5 acres 2 roods 15 poles?

11. Find the expense of paving an area 125 ft. 8 in. long and 48 ft. 6 in. broad, at 1*s.* 4*d.* per square yard.

ANSWERS.

I.

1. $3\frac{31}{120}$.
2. $17\frac{7}{8}$.
3. $\frac{4}{7}$.
4. $2\frac{10}{17}$.
5. 296·09218.
6. 9·8202.
7. ·3421575.
8. 148·279.
9. £2 1*s.* 8*d.*
10. 149328 oz.
11. £7 8*s.* $6\frac{1}{2}$*d.*
12. £155 10*s.* $4\frac{4}{5}$*d.*
13. $9\frac{5}{24}$.
14. $4\frac{343}{380}$.
15. $2\frac{2}{3}$.
16. $\frac{41}{58}$.
17. 3795 min.
18. 68·38 cwt.
19. 36·1875.
20. ·0196.
21. 74·8 yards.
22. 120 s. yds. 8 ft. 32 in.
23. £1449.
24. $2\frac{1}{2}$.
25. £113 4*s.* $7\frac{1}{2}$*d.*
26. 4.

II.

1. $10\frac{11}{30}$.
2. $5\frac{2}{3}$.
3. 21.
4. $4\frac{1}{18}$.
5. 181·649.
6. 80·678.
7. 21805·056.
8. 41·06.
9. 981·75.
10. 1248.
11. 152.
12. £84.
13. $8\frac{23}{42}$.
14. $2\frac{28}{39}$.
15. $8\frac{1}{2}$.
16. $\frac{21}{55}$.
17. 27690 lbs. 4·672 oz.
18. £4 8*s.* 7·56*d.*
19. ·02759168.
20. ·001802.
21. ·00004093.
22. 370·6.
23. ·0015625.
24. £40 18*s.* $7\frac{1}{2}$*d.*
25. 5.
26. $3\frac{1}{8}$.

III.

1. $3\frac{1}{21}$.
2. $1\frac{22}{35}$.
3. $\frac{2}{3}$.
4. $\frac{45}{82}$.
5. 3353·66458.
6. 302·4005.
7. 3·158316.
8. ·177.
9. £10 4*s.* 2*d.*
10. 58 mi. 3 f. 39 po. 4 yds. 1 ft. 11 in.
11. £2 10*s.* $3\frac{3}{4}$*d.*
12. £2601 9*s.*
13. $9\frac{49}{108}$.
14. $2\frac{51}{143}$.
15. 6.
16. $3\frac{8}{65}$.
17. 9 quarts.
18. 1 h. 23 m. 15 s.
19. 3·2304328.
20. 36500.
21. ·048828125.
22. 9 a. 29 p. 26 y. 6 ft. 82 in.
23. 1*s.* 2*d.*
24. 9*s.* $8\frac{1}{2}$*d.*
25. 7.
26. £7 12*s.* $4\frac{3}{4}$*d.*
27. 10 days.

IV.

1. $3\frac{9}{32}$.
2. $2\frac{41}{60}$.
3. $29\frac{1}{9}$.
4. $1\frac{4}{9}$.
5. 3325·87279.
6. 46·89054.
7. 1·38989004.
8. ·125.
9. 1*s.* $11\frac{1}{5}$*d.*
10. 11 tons 17 cwt. 4 lbs.
11. £7.
12. £2227 10*s.*
13. $8\frac{5}{18}$.
14. $6\frac{47}{60}$.
15. $\frac{35}{54}$.
16. 26.
17. 15·59 oz.
18. 11·4*d.*
19. 1·6619474.
20. 444.
21. ·025.
22. 9531756.
23. £8 1*s.*
24. 2*s.* 6*d.*
25. $3\frac{1}{4}$ years.
26. £14 3*s.* $1\frac{1}{2}$*d.*
27. 4.

V.

1. $7\frac{47}{144}$.
2. $3\frac{61}{110}$.
3. $41\frac{1}{3}$.
4. $4\frac{6}{103}$.

3332·38699.

6. 180·81815.
7. ·4487775.
8. ·25.
9. 31·065.
10. 6792.
11. $\frac{11}{16}$ ton, or, 13 cwt. 3 qrs.
12. £418.
13. $10\frac{121}{300}$.
14. $5\frac{697}{770}$.
15. $\frac{1}{4}$.
16. $1\frac{34}{333}$.
17. 286·5.
18. 24·63 oz.
19. 2·4142003.
20. 440.
21. $\cdot 02\dot{7}$.
22. 54 m. 16 po. 4 y. 1 ft. 4 in.
23. £60.
24. 12 hrs. $17\frac{1}{2}$ min.
25. $4\frac{1}{2}$.
26. £9 5*s.* 3*d.*
27. 13*s.* 4*d.*

VI.

1. $11\frac{13}{20}$.
2. $7\frac{331}{390}$.
3. 92.
4. $\frac{42}{155}$.
5. 539·58519.
6. 102·910604.
7. 1·6083405.
8. ·455.
9. 110*d.*
10. 42256 oz.
11. 43 a. 1 r.
12. £185 14*s.* 9*d.*
13. $14\frac{79}{144}$.
14. $25\frac{251}{280}$.
15. $84\frac{3}{4}$.
16. $1\frac{1}{2}$.
17. $9\frac{3}{4}$*d.*
18. ·27 pint.
19. ·03374679.
20. 1240.
21. $\cdot 0\dot{2}3809\dot{5}$.
22. 40 lbs. 8 oz. 7 gr.
23. £3 15*s.*
24. £945.
25. $3\frac{3}{4}$ years.
26. £4 9*s.* $0\frac{3}{4}$*d.*
27. £17 14*s.*

VII.

1. $8\frac{119}{198}$.
2. $4\frac{2}{5}$.
3. 9.
4. $1\frac{1}{2}$.
5. 534·96309.
6. 343·780696.
7. ·1783815.
8. ·064.
9. 1281.
10. 13056 grains.
11. 13*s.* 4*d.*
12. £396 1*s.* $6\frac{3}{5}$*d.*
13. $17\frac{19}{100}$.
14. $6\frac{349}{432}$.
15. $1\frac{451}{1240}$.
16. $2\frac{1}{2}$.
17. 2*s.* $11\frac{11}{20}$*d.*
18. 65·875 poles.
19. 1·590855.

20. ·1898.
21. 434.
22. ·00728.
23. $\cdot 053\dot{5}71428\dot{8}$.
24. 90 tons 4 cwt. 3 qrs. 8 lbs. 7 oz.
25. £9.
26. 19 acres.

VIII.

1. $7\frac{20}{21}$.
2. $4\frac{43}{72}$.
3. $18\frac{2}{3}$.
4. $1\frac{1}{6}$.
5. 360·248.
6. 7·1881.
7. 664·9244.
8. 24·9.
9. 137·34.
10. 252.
11. 15.
12. £184 16*s.*
13. $8\frac{43}{120}$.
14. $3\frac{31}{56}$.
15. $58\frac{4}{5}$.
16. $1\frac{47}{80}$.
17. 5155 lbs. 14·272 oz.
18. 11*s.* $6\frac{3}{25}$*d.*
19. ·0885891.
20. ·3444.
21. 24·2.
22. ·00182.
23. ·05.
24. £6 16*s.* 8*d.*
25. £1500 10*s.*
26. £201.

IX.

1. $6\frac{59}{117}$.
2. $\frac{17}{42}$.
3. $34\frac{2}{3}$.
4. $\frac{9}{16}$.
5. 1572·5723.
6. 3·6997.
7. 315·88568.
8. 11·4.
9. 50·4*d.*
10. 700.
11. $202\frac{1}{2}$ yards.
12. £243 7*s.* $2\frac{2}{5}$*d.*
13. $6\frac{17}{60}$.
14. $2\frac{29}{48}$.
15. $88\frac{4}{5}$.
16. $1\frac{3}{4}$.
17. 5956 lbs. 6·816 oz.
18. 14*s.* 6*d.*
19. ·32010468.
20. ·6804.
21. 121·3.
22. 83·32.
23. ·415.
24. £74.
25. $2\frac{1}{2}$.
26. £50 12*s.* 6*d.*

X.

1. $3\frac{17}{90}$.
2. $6\frac{17}{18}$.
3. $\frac{3}{8}$.
4. $3\frac{7}{16}$.
5. 73·547045.
6. 292·1468.
7. ·289918.
8. 34·114.
9. £10 5*s.*
10. 2 wks. 11 hrs. 26 min. 24 sec.
11. 19*s.* $11\frac{1}{4}$*d.*
12. £190 6*s.* $4\frac{4}{5}$*d.*
13. $7\frac{9}{100}$.
14. $4\frac{15}{16}$.
15. $8\frac{7}{16}$.
16. $\frac{15}{22}$.
17. 90·16 yards.
18. 82·94 hours.
19. ·319792.
20. ·0242.
21. $\cdot 1\dot{6}$.
22. 174 c. yds. 22 ft. 544 in.
23. £5062 10*s.*
24. 13 years.
25. £1621 9*s.* 10*d.*
26. £30.

XI.

1. $5\frac{123}{252}$.
2. $\frac{7}{8}$.
3. $4\frac{2}{9}$.
4. $7\frac{2}{7}$.
5. 6008·51356.
6. 646·738.
7. 600·88060627.
8. 7·6.
9. 228·125.
10. 82 mi. 1 f. 21 po. 1 yd. 1 ft. 7 in.
11. £1054 4*s.*
12. £423.
13. $26\frac{127}{324}$.
14. $3\frac{5}{8}$.

15. $388\frac{8}{9}$.
16. $1\frac{3557}{5488}$.
17. 1006·686 s. ft.
18. 655·16 pints.
19. 74·5421712.
20. ·0006936.
21. ·083176.
22. 4790.
23. ·95 cwt.
24. 15 for 7*d.*
25. 5 per cent.

XII.

1. $4\frac{23}{48}$.
2. $6\frac{111}{260}$.
3. $56\frac{2}{5}$.
4. 10.
5. 563·84793.
6. 88·1744.
7. 184·2872108.
8. ·624.
9. 130·816.
10. 19320.
11. £3 7*s.* $2\frac{13}{64}$*d.*
12. £165 2*s.*
13. $17\frac{83}{196}$.
14. $20\frac{689}{720}$.
15. $\frac{1}{6}$.
16. $\frac{301}{856}$.
17. 135·66.
18. 30·88.
19. ·08936913.
20. ·07280812.
21. 5400.
22. ·000199.
23. $\cdot 208\dot{3}$.
24. $19\frac{1}{4}$.
25. $7\frac{1}{2}$ years.

XIII.

1. $3\frac{269}{459}$.
2. $1\frac{53}{161}$.
3. $23\frac{1}{8}$.
4. 12.
5. 154·26536.
6. 201·50499.
7. 496·5566489.
8. ·133.
9. 1831·424.
10. 29832.
11. £8718 15*s.*
12. £415 16*s.*
13. $9\frac{31}{84}$.
14. $4\frac{50}{561}$.
15. $\frac{20}{47}$.
16. $1\frac{73}{105}$.
17. 7813·74.
18. 72·352.
19. 302·2170811.
20. 112·187078.
21. ·0301.
22. ·0000579.
23. $\cdot 1458\dot{3}$.
24. $108\frac{1}{2}$ tons.
25. £4100.

XIV.

1. $1\frac{3}{40}$.
2. $17\frac{5}{6}$.
3. 28.
4. $1\frac{859}{975}$.
5. 210·99736.
6. 72·678125.
7. 2019·11556.
8. ·0245.
9. 5·2192.
10. 120924.
11. £7 18*s.* 8*d.*
12. £321 15*s.*
13. $11\frac{269}{528}$.
14. $3\frac{71}{140}$.
15. $21\frac{7}{9}$.
16. $1\frac{1}{2}$.
17. 117·5185.
18. 8·304.
19. 1·2896342.
20. ·0048178819.
21. 514720.
22. ·0051472.
23. $\cdot 347\dot{2}$.
24. $5\frac{1}{3}$ oz.
25. $3\frac{1}{2}$ years.

XV.

1. $5\frac{4}{11}$.
2. $4\frac{11}{28}$.
3. $20\frac{2}{5}$.
4. $3\frac{6}{7}$.
5. 572·98829.
6. 46·334916.
7. 80·2838764.
8. 13·5.
9. ·00625.
10. $12595\frac{1}{2}$.
11. £12.
12. £612 8*s.* 6*d.*
13. $7\frac{2650}{3003}$.
14. $7\frac{61}{112}$.
15. $1\frac{17}{19}$.
16. $\frac{83}{464}$.
17. 45·6896.
18. 2·5 pints.
19. 1·37903883.
20. ·0024707221.

21. 53200.
22. ·00555.
23. 24·59268.
24. 25.
25. $3\frac{3}{4}$.

XVI.

1. $9\frac{65}{198}$.
2. $5\frac{307}{550}$.
3. $7\frac{7}{9}$.
4. 6.
5. 148·64236.
6. 64·0888.
7. 3·322190065.
8. ·435.
9. 26·64.
10. 26826.
11. £6 10*s*.
12. £71 10*s*.
13. $8\frac{347}{1700}$.
14. $6\frac{117}{380}$.
15. $138\frac{10}{33}$.
16. $\frac{107}{252}$.
17. 5782·59.
18. 218·9.
19. 48·5392071.
20. ·14763749.
21. 4·29.
22. 66600.
23. ·0003125.
24. 9.
25. $8\frac{3}{4}$ years.

XVII.

1. $14\frac{9}{10}$.
2. $5\frac{67}{81}$.
3. $2\frac{5}{8}$.
4. $\frac{9}{220}$.
5. 4639·55663.
6. 8803·96427.
7. 273·9246906.
8. ·0082.
9. 4124·952.
10. 5 a. 2 r. 10 y. 2 ft. 108 in.
11. £1 13*s*. 4*d*.
12. £4425.
13. $18\frac{105}{136}$.
14. $1\frac{19}{72}$.
15. $\frac{17}{56}$.
16. $\frac{11}{84}$.
17. 25200·288.
18. 243·408.
19. 1704·634305.
20. 105·05668608.
21. 119·569.
22. ·083246.
23. ·1458$\dot{3}$.
24. 10.
25. $7\frac{1}{2}$.

XVIII.

1. $5\frac{217}{360}$.
2. $3\frac{5}{9}$.
3. 21.
4. 9.
5. 134·20936.
6. 1133·19875.
7. 2·361204.
8. ·236.
9. 5·6125.
10. £27 19*s*. 7*d*.
11. 11 tons 19 cwt. 3qrs. 14lbs. 9oz.
12. £1678 1*s*.
13. $14\frac{7}{9}$.
14. $2\frac{26}{81}$.
15. $\frac{57}{100}$.
16. $10\frac{5}{7}$.
17. 428·4.
18. 160·38.
19. 437·16992.
20. ·000034927.
21. ·018848...
22. 3461·676...
23. ·1015625.
24. $5\frac{1}{4}$ weeks.
25. 4 per cent.

XIX.

1. $4\frac{2}{5}$.
2. $2\frac{347}{528}$.
3. 20.
4. 3.
5. 197·19546.
6. 4674·162.
7. 16·894668.
8. ·0245.
9. 8·272.
10. £5393 1*s*. 11*d*.
11. 224 a. 2 r. 26 po. 25 y. 7 ft. 72 in.
12. £1478 15*s*.
13. $12\frac{171}{560}$.
14. $2\frac{58}{63}$.
15. 36.
16. 6.
17. 19754·88.
18. 2026·248.
19. 853·07265.
20. ·1233336.
21. 40000.
22. ·0437.
23. 1·032.

24. 2 tons 10 cwt. 3 qrs. 2 lbs. 8 oz.
*25. 10.

XIX.*

1. 13 $\frac{1}{20}$.
2. 3 $\frac{37}{88}$.
3. 11 $\frac{5}{8}$.
4. 5 $\frac{21}{284}$.
5. 355·46905.
6. 232·4335.
7. 6·02029775.
8. ·325.
9. 70·47.
10. £99 4*s.* 1½*d.*
11. 109936.
12. £871 13*s.* 6*d.*
13. 8 $\frac{47}{132}$.
14. 2 $\frac{32}{35}$.
15. 5½.
16. $\frac{5}{8}$.
17. 423·72.
18. 26048·88.
19. 302·203165.
20. ·001173024.
21. 555.
22. ·00243.
23. ·078125.
24. £10112 10*s.*
25. 9¼ years.

XX.

1. 598 s. ft. 128 in.
2. 3, 9, 27, $\frac{1}{3}$, $\frac{1}{9}$, $\frac{1}{27}$, $\sqrt{10}$, 8286·972.
3. 38400 s. ft.
4. 12470·4 cub. ft.
5. 60 ft., 103·92 ft.

XXI.

2. $x=2$, ·5740313, $\bar{1}$·7501225, ·6573238, 6.
3. 7 $\frac{8}{9}$, 1458·04.
4. 189 inches.
5. £17 6*s.* 6*d.*
7. £6 1*s.* 11*d.*

XXII.

1. 5, −6.
2. 1·8573325, 2·1303338, $\bar{1}$·7406163.
3. 1 to 506880.
4. 27 in.; 27$\sqrt{3}$ in. or 46·765.
5. 2 miles.
7. ·4771213, ·6989700.
8. 4·54.

XXIII.

1. 1·333... feet, 1·777... feet.
2. £24 10*s.*
3. 709½ lbs.
4. 25 chains.
5. 15.
7. $\bar{2}$·7958800, 1·1583626.
8. 2·9325462, $\bar{3}$·9325462.

XXIV.

1. 2·2798950, 5·2801131, 1905·207.
2. 2, 5, −6, −4, −2, −5, 6, 4.
3. ·374408.
4. 13 cubic feet.
5. 5 feet.
6. 3466145.

XXV.

1. 4, 12, 4, −12.
2. 2·6883872, 1·118802.
3. 595, 84966.
4. 11·514, 8·5942.
5. 44196 $\frac{3}{7}$.
6. 5026·56, 4398·24.

XXVI.

1. 78 yds., 58 yds.
2. £29 14*s.*
3. 11·46, 9, 6·93.
4. 3·968626 ac., 6·614378 ch.
5. 151·2.
6. $\bar{1}$·969897, $\bar{3}$·30103, $\bar{1}$·860206, 3·7958800.
7. $x=2·321...$
8. 2·9005386, ·07953152.

XXVII.

1. 3, 5, 7.
2. 1·9096256, 2·9096256, 4·9096256, $\bar{2}\cdot9096256$.
3. 2·5563025.
4. 2·52.
5. 9360.
6. 1728, 823·2192 cubic inches.
7. £2 15*s.*
8. 15·15 lbs.

XXVIII.

1. £5 9*s.* $1\frac{1}{2}$*d.*
2. 7·45, 3·39.
3. 2513·28 cub. ft.
4. ·577, ·816.
5. $6\frac{3}{4}$ acres.
6. $\frac{mx}{n}$, 8, −4, $\bar{1}\cdot4$, −8.
7. ·3010300, ·4771213, ·6020600, ·6989700, ·7781513, ·8450980, ·9030900, ·9542425.
8. 1·565065.

XXIX.

1. 6 yards, 1 yard.
2. $754\cdot7\dot{2}$.
3. 66 lbs. $10\frac{181}{324}$ oz.
5. $\bar{1}\cdot8494850$, $\bar{1}\cdot8409596$, $\bar{1}\cdot8316167$, ·01332556.
6. 1*s.* 3*d.*

XXX.

1. 14, 28, 42, 56, 70, 83, 97, 111, 125; 4·4941999.
2. $\bar{4}\cdot0969100$, 5, $\bar{3}\cdot8782800$.
3. 2 a. 37 po. 6 ft. 108 in.
4. 50·2656 lbs.
5. 171·709056 sq.ft., 249·4152 c. ft., 6·349604 feet from top.

XXXI.

1. 1·556 nearly.
3. $2292\frac{3}{8}$ cub. feet., 173 tons 19 cwt. 1 qr. $27\frac{3}{4}$ lbs.
4. 323·84 yards.
5. 5·38765625 per cent.

XXXII.

1. ·3891661, 1·3502480.
2. 6 a. 3 r. 37 po. 10 yds. 6 ft. 108 in.
3. 472.
4. £16 13*s.* 4*d.*
5. 1 inch.
6. $2\frac{1427}{3168}$ inches a minute.

XXXIII.

1. $1\frac{115}{252}$.
2. $12\frac{7}{15}$.
3. $3\frac{16}{21}$.
4. $\frac{39}{50}$.
5. 773·65738.
6. 618·5246.
7. ·062068.
8. ·0000589.
9. ·067.
10. $7\frac{73}{300}$.
11. $4\frac{28}{33}$.
12. $1\frac{3}{11}$.
13. $\frac{41}{111}$.
14. 7489·59.
15. 4994.
16. ·056536.
17. 168·960.
18. ·04875.
19. 7427.
20. 1*s.* $10\frac{1}{2}$*d.*
21. £5946 15*s.* $3\frac{3}{4}$*d.*
22. £594.
23. 152550.
24. $52\frac{1}{2}$.
25. £752 6*s.* $10\frac{1}{2}$*d.*
26. £7524 11*s.* 3*d.*
27. 131·243.
28. ·6989700, ·7781513, $\bar{2}\cdot3344538$, $\bar{1}\cdot9148063$.

29. 62573, $\frac{210}{23}$.
30. £220 7*s.* $5\frac{17}{47}$*d.*
31. £993 4*s.* 6*d.*

XXXIV.

1. $8\frac{11}{18}$.
2. $1\frac{52}{105}$.
3. 15.
4. $\frac{29}{38}$.
5. 29.
6. 74·292.
7. 12·1067415.
8. 59·049.
9. ·00012.
10. $16\frac{2368}{3740}$.
11. 1.
12. 3.
13. $\frac{4}{5}$.
14. 2 mi. 8 fur.
15. ·199539504.
16. ·3183.
17. $\cdot 29\dot{5}\dot{4}$.
18. 350 a. 1 r. 11 po. 29 yds. 6 ft. 136 in.
19. £1 11*s.* 4*d.*
20. £36404 17*s.* $9\frac{3}{4}$*d.*
21. £398 13*s.* $10\frac{1}{5}$*d.*
22. 15 m. 6 f. 10 po. 2 yds. 2 ft. 4 in.
23. 58.
24. £103 12*s.*
25. 253, 1·4142, ·6324.
26. $50\frac{1}{2}$.
27. 1165·695.
28. 38 years.

XXXV.

1. $8\frac{41}{120}$.
2. $2\frac{60}{221}$.
3. 45.
4. $\frac{83}{86}$.
5. 80·1272457.
6. 230·039346.
7. 4·1971062.
8. 7436·1.
9. $\cdot 41\dot{6}$.
10. $8\frac{1}{9}$.
11. $1\frac{14}{89}$.
12. $14\frac{448}{943}$.
13. $1\frac{1}{2}$.
14. 111·288 poles.
15. ·06421875.
16. ·223731868.
17. 563·1860.
18. $\cdot\dot{2}8571\dot{4}$.
19. $23806\frac{3}{4}$.
20. 4*s.* $4\frac{1}{2}$*d.*
21. £4147 19*s.* $0\frac{3}{4}$*d.*
22. £609 1*s.* $10\frac{1}{2}$*d.*
23. 162 tons 17 cwt. 3 qrs. 25 lbs. 9 oz.
24. $13\frac{1}{2}$ weeks.
25. £2734 15*s.* $3\frac{3}{16}$*d.*
26. £7699 13*s.* 10·5792*d.*
27. $22\frac{11}{16}$, 3·606.
28. £2 2*s.* $6\frac{1}{2}$*d.*
29. 5451·6925.
30. 1·845818.

XXXVI.

1. $5\frac{23}{45}$.
2. $\frac{7}{18}$.
3. $2\frac{2}{9}$.
4. 22.
5. 137·9451.
6. 250·9993.
7. 105·372905.
8. 134·2.
9. ·003125.
10. $16\frac{37}{60}$.
11. $\frac{1}{44}$.
12. $1\frac{4}{5}$.
13. $4\frac{1}{5}$.
14. 2938·402.
15. 1·7479401.
16. ·000018.
17. ·625.
18. 372 a. 1 r. 27 po. 20 y. 1 ft. $74\frac{1}{24}$ in.
19. £25600.
20. £42081.
21. £585 4*s.* 10·512*d.*
22. 60.
23. £2118 15*s.* 7*d.*
24. 3·13, ·8366.
25. ·3107278.
26. £2803 5*s.* 2*d.*

XXXVII.

1. $14\frac{3}{16}$.
2. $9\frac{78}{95}$.
3. $3\frac{5}{9}$.
4. $\frac{32}{33}$.
5. 295·67.

6. 14·98756.
7. 469.625.
8. 32·114.
9. ·43625.
10. 99$\frac{17}{45}$.
11. 5$\frac{55}{96}$.
12. 335$\frac{5}{17}$.
13. $\frac{169}{210}$.
14. 22·29$\dot{4}$ lbs.
15. 288·975.
16. 700310.
17. $\frac{1}{44}$ or ·02$\dot{2}\dot{7}$.
18. 5 tons 16 cwt. 2 qrs. 11 lbs.
19. £1 9*s.* 6*d.*
20. £921506 5*s.* 6*d.*
21. £41 18*s.* 2$\frac{3}{4}$*d.*
22. 15.
23. 4.
24. 30507, 1·43...
25. 164·04674...
26. £5066 14*s.*

XXXVIII.

1. 14$\frac{11}{24}$.
2. 6$\frac{5}{18}$.
3. 91$\frac{13}{23}$.
4. $\frac{24}{25}$.
5. 23·45.
6. 1·2345.
7. 25·29.
8. 14·05.
9. ·3125.
10. 98$\frac{1}{5}$.
11. $\frac{3}{4}$.
12. 22$\frac{1}{2}$.
13. 11$\frac{2}{3}$.
14. 13·2275.
15. ·00056.
16. 97·5.
17. ·31375.
18. 3 fur. 27 po. 3 y.
19. £12 12*s.*
20. £3847 6*s.* 7$\frac{1}{2}$*d.*
21. 2$\frac{1}{2}$.
22. 25.
23. £1 3*s.* 3$\frac{22481}{300000}$*d.*
24. 2·17, 4·2426408 in.
25. ·7928536.
26. £8315 10*s.*

XXXIX.

1. 9$\frac{59}{63}$.
2. $\frac{4}{63}$.
3. 123$\frac{3}{4}$.
4. $\frac{160}{201}$.
5. 24.36.
6. 2·114.
7. 30.16.
8. 470.
9. 3·8.
10. ·1$\dot{8}$.
11. 1 fur. 4 po. 3 y.
12. 24.
13. £3696 12*s.* 9*d.*
14. £720 9*s.* 9$\frac{3}{4}$*d.*
15. 26$\frac{2}{3}$.
16. £501 12*s.* 9*d.*
17. £1040.
18. £90.
20. $\frac{47}{28}$, 729.
21. 20·7846, 203·646672.
22. 1·5440680, $\bar{2}$·2464986, $\bar{1}$·9457336.
23. £1392 19*s.* 7$\frac{1}{2}$*d.* nearly.

XL.

1. 4$\frac{13}{14}$.
2. 3$\frac{13}{108}$.
3. 38$\frac{8}{9}$.
4. 3$\frac{175}{209}$.
5. 30·8.
6. ·056068246.
7. 575.
8. ·012.
9. 302·3424.
10. ·0028125.
11. 5 cwt. 48 lbs. 15$\frac{4}{5}$ oz.
12. 4.
13. £2341 11*s.* 11$\frac{1}{4}$*d.*
14. 4$\frac{1}{4}$.
15. £446 10*s.*
16. £2727 15*s.* 10·848*d.*
17. 18.
18. 3·15$\dot{5}\dot{0}$*s.*
19. £120.
20. £2 5*s.* 1$\frac{7}{8}$*d.*
21. £1023 6*s.* 8*d.*
22. $\bar{1}$·5440680, 1·5854607.
23. ·001707063.

XLI.

1. 21$\frac{16}{85}$.
2. 7$\frac{11}{34}$.
3. 16$\frac{1}{4}$.

4. 8.
5. 63·728.
6. 5·935191.
7. ·125.
8. 65800.
9. ·0625.
10. 57·85065.
11. 1 lb. 5 oz. 17 dwts. 9 grs.
12. $66\frac{2}{3}$ hours.
13. £1 6*s.* 9*d.*
14. $9\frac{1}{2}$ years.
15. £44 0*s.* 10*d.*
16. £2857 3*s.* 1*d.*
17. 15 cubic feet $1182\frac{107}{144}$ c. in.
18. £86 1*s.* $8\frac{20}{23}$*d.* increase.
19. 2*s.* 3*d.*
20. $1\frac{8}{9}$, 13·05.
21. 65120.
22. 1·5185140, $\bar{3}$·2966653, 3·0407755.
23. £279620 6*s.* 6*d.* nearly.

XLII.

1. $19\frac{185}{208}$.
2. $\frac{499}{1320}$.
3. $341\frac{13}{55}$.
4. $\frac{29}{90}$.
5. 663·18.
6. 2·33271428.
7. ·0645.
8. 296000.
9. ·115625.
10. 547·01425.
11. 1 a. 3 r. 33 po. 4 yds.
12. 24 hours.
13. £2340 12*s.* $4\frac{1}{4}$*d.*
14. $8\frac{1}{4}$.
15. $4\frac{1}{8}$*d.*
16. £4285 19*s.* 7*d.*
17. $6696\frac{31}{32}$ cub. ft.
18. Rent £120, income £300.
19. £20 13*s.* 4*d.*
20. 31·87, $\frac{23}{14}$.
21. 4 inches.
22. 1·8920947, $\bar{3}$·5910647, 8·496253.
23. ·906015 miles.

XLIII.

1. $11\frac{3037}{3060}$.
2. $63\frac{1618}{1659}$.
3. $5\frac{5}{16}$.
4. $19\frac{1}{5}$.
5. 58·2552.
6. ·3493296.
7. 98·9.
8. 2500000.
9. 372·096.
10. ·6005.
11. 3 r. 5 p. 27 yds. 4 ft. 72 ins.
12. $9\frac{7}{20}$.
13. £94 0*s.* $1\frac{7}{8}$*d.*
14. $4\frac{1}{2}$.
15. £196 10*s.*
16. £2745 14*s.* 10*d.*
17. 3·47, $\frac{73}{19}$.
18. 99 cubic feet $1126\frac{5}{16}$ cub. in.
19. £6 19*s.*
20. $18\frac{387}{721}$ min. to 3.
21. £18 5*s.* $2\frac{14}{23}$*d.*
22. $\bar{2}$·3424227, 1·4807254.
23. 10·9206036.

XLIV.

1. 3 lbs. 7 oz. 8 dwts.
2. 725.
3. 2*d.*
5. ·9961.
6. 78·5251584.
7. 54950.
8. Passes, answers 52 per cent.
9. £25.
10. 1949·6.
11. 83·5505 acres.
12. 192000.
13. 14·71875 sq. in., 14·75 sq. in.

XLV.

1. $9\frac{203}{240}$.
2. $1\frac{47}{51}$.
3. $\frac{5}{256}$.
4. $\frac{3}{4}$.
5. 4752·131585.
6. 97·38773.
7. 604·1652.
8. 79·3065.
9. ·01875.
10. $22\frac{9}{35}$.

11. $65\frac{33}{40}$.
12. 546.
13. $1\frac{16}{27}$.
14. 979·08.
15. 52 hrs. 16 min. 48 sec.
16. 27·6022.
17. ·9638.
18. $\cdot 01597\dot{2}$.
19. £518 6*s.* $1\frac{1}{4}$*d.*
20. 125 a. 1 r. 25 p. 7 yds. 4 ft. 108 in.
21. 38.
22. £3 14*s.*
23. 133 cub. ft. $1677\frac{1}{4}$ cub. in.
24. $12\frac{1}{2}$ inches.
25. 4502 links.
26. 8448000 gals.
27. 6·995 cubic feet nearly.
28. 150 lbs.
29. 3 r. 5 p. $28\frac{1}{2}$ yds. nearly.

XLVI.

1. $13\frac{13}{36}$.
2. $1\frac{49}{57}$.
3. $3\frac{15}{16}$.
4. 2.
5. 5627·737198.
6. 895·75905.
7. ·003904634056.
8. ·113.
9. $\cdot 1\dot{6}$.
10. $11\frac{7}{16}$.
11. $77\frac{4}{45}$.
12. $130\frac{3}{4}$.
13. 21.
14. 27·3525.
15. 244·788 hours.
16. 638·3587702413.
17. 12677·3558.
18. $\cdot\dot{1}4285\dot{7}$.
19. £577 12*s.* $6\frac{3}{4}$*d.*
20. 86 mi. 1 f. 29 po. 3 y. 2 ft. 10 in.
21. $14\frac{14}{15}$.
22. 23 po. 1 ft. 6 in.
23. 158 cub. ft. $1507\frac{7}{12}$ cub. in.
25. 5·1416.
26. 8.
27. 19·425 s. in., $19\cdot 41\dot{6}$ s. in.
28. 360 π, 792 π.

XLVII.

1. $10\frac{73}{75}$.
2. $1\frac{1}{35}$.
3. $5\frac{41}{80}$.
4. $2\frac{1}{19}$.
5. 1742·914533.
6. 279·02283.
7. ·092078038774.
8. ·031.
9. ·325.
10. $6\frac{157}{231}$.
11. $34\frac{8}{39}$.
12. $\frac{18}{77}$.
13. $31\frac{35}{62}$.
14. 2042·55.
15. 111·479 lbs.
16. 9336·5038292703.
17. 641·783.
18. ·248.
19. £3 4*s.* 11*d.*
20. 255, 357.
21. 43 mi. 7 f. 23 po. 3 yds. 1 in.
22. 795·965 yards.
23. 69·282 inches.
25. $\frac{5}{6}$.
26. 3 feet.
27. 3 a. 26·4... po.

XLVIII.

1. $12\frac{19}{120}$.
2. $\frac{3}{28}$.
3. $3\frac{123}{400}$.
4. $10\frac{16}{25}$.
5. 1749·1304843.
6. 81·0466.
7. 2·3794730796.
8. 350·62.
9. ·7025.
10. $5\frac{181}{462}$.
11. $11\frac{11}{40}$.
12. 2.
13. $1\frac{19}{21}$.
14. 6369.
15. 9·16 oz.
16. 4·607682336.
17. 4024·745.
18. 1 cwt. 2 qr. 10 lb. 13·5552 oz.
19. £65 0*s.* $0\frac{7}{12}$*d.*
20. 64.
21. 3*s.* 11...*d.*
22. 23 ft. 2 in.
23. 220·617228... yards.

24. £809424.
25. 2796.
26. 172 nearly.
27. 3.

XLIX.

1. $18\frac{131}{720}$.
2. $1\frac{1}{56}$.
3. $\frac{1}{3}$.
4. $1\frac{29}{172}$.
5. 1740·4968853.
6. 6·9193.
7. ·913445.
8. ·0130763.
9. 3·96396.
10. $15\frac{11}{24}$.
11. $28\frac{5}{6}$.
12. $1\frac{2}{25}$.
13. $31\frac{4}{21}$.
14. 5580.
15. 254·164 yards.
16. ·000035800665.
17. 411·076...
18. 2 r. 15 po. 15 y. 5·184 in.
19. £1040.
20. £3 5*s*. $9\frac{3}{8}$*d.*
21. 12·5664 sq. ft.
22. 3 ft. 0·48 in.
23. 2·315 h. nearly.
24. 243·551048... square feet.
25. $10\frac{4}{11}$ inches.
26. 259·8075.
27. 35 ch. 71·428... links, 785 yds. 2 ft. 1·7...in.

L.

1. $14\frac{1}{18}$.
2. $\frac{37}{56}$.
3. $11\frac{1}{121}$.
4. 10.
5. 270·458595.
6. 212·8541.
7. ·389464.
8. 10·64.
9. ·1390625.
10. $3\frac{3}{13}$.
11. $\frac{100}{143}$.
12. $4\frac{26}{81}$.
13. $2\frac{1}{147}$.
14. 46·90625.
15. 206.25.
16. 8·186848735.
17. 18472.
18. 17458·56.
19. $151\frac{1}{2}$ days.
20. 42 cubic feet $684\frac{5}{48}$ cub. in.
21. £6 17*s*. $9\frac{3}{4}$*d.*
22. $303\frac{1}{3}$.
23. £14 17*s*.
24. £4 5*s*. $6\frac{3}{4}$*d.*
25. 864.

LI.

1. £5454237 19*s*. 5*d*.
2. £5329221 14*s*. 7*d*.
3. £6702998 5*s*. 9*d*.
4. £4971025 0*s*. 8*d*.
5. £4379048 4*s*. 6*d*.
6. £5483799 2*s*. 1*d*.
7. £5579082 4*s*. 2*d*.
8. £5563671 3*s*. 4*d*.
9. £6343704 12*s*. 3*d*.
10. £6142511 10*s*. 11*d*.
11. £2471698 3*s*. 5*d*.
12. £6021957 8*s*. 1*d*.
13. £3819462 8*s*. 11*d*.
14. £3832937 11*s*. 9*d*.
15. £4831328 15*s*. 11*d*.
16. £5835410 15*s*. 10*d*.
17. £4471894 18*s*. 4*d*.
18. £7445073 0*s*. 7*d*.
19. £5143639 4*s*. 1*d*.
20. £5127440 7*s*. 9*d*.
21. £3579828 11*s*. 10*d*.
22. £3007984 16*s*. 0*d*.
23. £6138183 6*s*. 10*d*.
24. £4310524 17*s*. 4*d*.
25. £4550180 19*s*. 8*d*.
26. £3937227 2*s*. 6*d*.
27. £5124234 1*s*. 3*d*.
28. £6941869 16*s*. 8*d*.

29. £4574788 13*s.* 3*d.*
30. £6235720 4*s.* 9*d.*
31. £5121979 10*s.* 4*d.*
32. £4349528 13*s.* 2*d.*
33. £8014949 16*s.* 3*d.*
34. £4099812 0*s.* 11*d.*
35. £5589072 9*s.* 4*d.*
36. £7797573 8*s.* 11*d.*
37. £3200085 18*s.* 4*d.*
38. £5127792 9*s.* 6*d.*
39. £6505993 19*s.* 5*d.*
40. £4874161 14*s.* 4*d.*
41. £4938894 9*s.* 6*d.*
42. £7673401 15*s.* 11*d.*
43. £1729759 18*s.* 10*d.*
44. £6575230 12*s.* 3*d.*
45. £5558614 17*s.* 6*d.*
46. £6958100 4*s.* 11*d.*
47. £5728383 2*s.* 8*d.*
48. £5065895 7*s.* 2*d.*

49. (1) 161294.
(2) 128267.
(3) 111314.
(4) 124044.
(5) 97334.
(6) 145359.
(7) 78286.
(8) 88598.
(9) 110606.
(10) 89700.
(11) 83619.
(12) 73960.
(13) 45842.
(14) 307931.
(15) 23791.
(16) 19794.
(17) 45832.
(18) 33056.

50. (1) 162347.
(2) 112333.
(3) 154028.
(4) 120396.
(5) 123785.
(6) 78940.
(7) 134722.
(8) 67911.
(9) 116609.
(10) 47117.
(11) 99845.
(12) 52933.
(13) 73895.
(14) 27008.
(15) 34297.
(16) 7594.
(17) 51353.
(18) 26514.

51. (1) 152115.
(2) 97919.
(3) 166815.
(4) 112873.
(5) 134525.
(6) 86823.
(7) 129084.
(8) 65104.
(9) 103432.
(10) 67636.
(11) 106514.
(12) 55945.
(13) 59001.
(14) 53294.
(15) 28848.
(16) 7047.
(17) 47329.
(18) 17323.

LII.

1. 87264.
2. 40 tons.
3. £16 11*s.* $11\frac{1}{4}$*d.*
4. £32 11*s.*
5. $17\frac{65}{84}$.
6. $8\frac{19}{20}$.
7. 39.
8. 16.
9. 4027·428609.
10. 613·87695.
11. 12951·6591.
12. 7372·4489.
13. 25800.
14. 598528.
15. 120.
16. £37 19*s.* $4\frac{1}{2}$*d.*
17. £1719 1*s.* $5\frac{11}{20}$*d.*
18. $13\frac{41}{80}$.
19. $\frac{71}{72}$.
20. 26.
21. $8\frac{4}{13}$.
22. 1359·787761.
23. 814·404736.
24. ·00334608.
25. 207·3681.

26. 176328.
27. 12256 bus. 1 gal. 2 qts.
28. £$27\frac{7}{8}$.
29. £2280 19s. 4d.
30. 5.
31. $2\frac{1}{60}$.
32. $10\frac{17}{21}$.
33. $8\frac{8}{9}$.
34. $3\frac{51}{59}$.
35. 2020·8977301.
36. ·9388343.
37. 84·11341512.
38. 80.
39. $1{\cdot}231302083\dot{3}$.

LIII.

1. 7 tons 3 cwt. 3 qrs. 5 lbs. 11 oz.
2. £17 6s. $1\frac{1}{2}$d.
3. £8090 10s. 8d.
4. £259 4s.
5. $7\frac{85}{168}$.
6. $5\frac{7}{24}$.
7. 18.
8. $\frac{203}{352}$.
9. 800·056901.
10. 21·06.
11. 3005·10652.
12. ·0057.
13. 24410·88.
14. 10065.
15. 105 days.
16. £502 6s. $10\frac{1}{2}$d.
17. £7315 16s. 2d.
18. $10\frac{13}{42}$.
19. $\frac{31}{35}$.
20. $\frac{29}{54}$.
21. $\frac{5}{27}$.
22. 217·6224563.
23. 1·9075.
24. 64·0736192.
25. ·2094.
26. 4·25.
27. 18792.
28. 24.
29. £558.
30. 10.
31. $12\frac{101}{120}$.
32. $\frac{19}{20}$.
33. $7\frac{7}{44}$.
34. $3\frac{59}{105}$.
35. 813·987803.
36. 109·353.
37. 443·30018719.
38. 16·4918.
39. ·0228125.

LIV.

1. 18312.
2. £5.
3. £1147 2s. $4\frac{1}{2}$d.
4. £288 8s.
5. $4\frac{5}{16}$.
6. $3\frac{85}{91}$.
7. $7\frac{2}{9}$.
8. $18\frac{22}{81}$.
9. 783·122203.
10. 2·0570101.
11. 4·85325142.
12. 1·7669.
13. 8·25.
14. 639 qrs. 4 bus. 2 pks. 2 qts. 1 pt.
15. 8.
16. £3 16s. $8\frac{1}{4}$d.
17. £8104 12s. 10d.
18. 7.
19. $4\frac{43}{63}$.
20. $\frac{2}{13}$.
21. $2\frac{1}{2}$.
22. 257·24718.
23. 10·64785.
24. ·005997496.
25. ·0735.
26. 1s. 6·522d.
27. 20860416.
28. $11\frac{1}{4}$ miles.
29. £9745 7s. $4\frac{1}{2}$d.
30. $2\frac{1}{2}$.
31. $5\frac{1}{14}$.
32. $\frac{5}{16}$.
33. 1.
34. $\frac{25}{28}$.
35. 1033·794547.
36. 29·11729.
37. 74·8144.
38. 8456.
39. $\cdot 000\dot{3}$.

LV.

1. 25 tons 2 qrs. 27 lbs. 6 oz.
2. $87\frac{3}{4}$ cwt.
3. £1221 19s. $11\frac{3}{4}$d.
4. £85 17s. $9\frac{3}{8}$d.
5. $14\frac{5}{12}$.
6. $2\frac{33}{34}$.
7. $11\frac{53}{77}$.
8. 5.
9. 714·3657.

10. 27·7083.
11. 447·77312.
12. ·1168.
13. 3564.
14. 36 mi. 7 f. 22 po.
    1 yd. 2 ft. 4 in.
15. 126.
16. £28 14*s.* $8\frac{1}{4}$*d.*
17. £1008 16*s.* 3*d.*
18. $13\frac{415}{504}$.
19. $\frac{43}{72}$.
20. $3\frac{73}{85}$.
21. 12.
22. 91·036485.
23. ·88094.
24. 2·0644261892.
25. 17·342.
26. 4 gal. 1 pint.
27. 20304.
28. 19*s.* $3\frac{1}{9}$*d.*
29. £10 3*s.* 4*d.*
30. 25 years.
31. $\frac{1}{6}$.
32. $\frac{3}{40}$.
33. $\frac{1}{5}$.
34. $\frac{46}{181}$.
35. £4 13*s.* 9*d.*
36. 7·561 cwt.
37. ·00002511239.
38. ·000003.
39. ·3921875.

LVI.

1. 3 tons 8 cwt. 3 qr.
   17 lbs. 4 oz.
2. £6 7*s.* $4\frac{4}{17}$*d.*
3. £32 3*s.*
4. £80 14*s.* 8*d.*
5. $3\frac{1081}{2520}$.
6. $6\frac{5}{8}$.
7. $\frac{2}{3}$.
8. 6.
9. 1079·362987.
10. 1·1099.
11. ·780092138.
12. ·2773.
13. 13968.
14. 9844092.
15. 26000.
16. £1724 17*s.* $2\frac{1}{2}$*d.*
17. £1086 13*s.* 6*d.*
18. $1\frac{59}{198}$.
19. $1\frac{5}{33}$.
20. $\frac{3}{5}$.
21. $3\frac{25}{33}$.
22. 1021·859571.
23. 2·63507.
24. ·037135824.
25. ·0164.
26. $90\frac{13}{20}$.
27. 6792.
28. 18.
29. £717388 0*s.* 6*d.*
30. $3\frac{1}{4}$.
31. $1\frac{115}{252}$.
32. $12\frac{59}{60}$.
33. $1\frac{3}{11}$.
34. $\frac{39}{80}$.
35. 843·667183.
36. 618·525401.
37. ·0619628.
38. ·0000589.
39. ·067.

LVII.

1. 20479032.
2. 350 lbs.
3. £19 7*s.* 11*d.*
4. £48 1*s.* $9\frac{3}{5}$*d.*
5. $7\frac{5}{8}$.
6. $7\frac{11}{24}$.
7. $\frac{5}{36}$.
8. $3\frac{9}{38}$.
9. 6253·948033.
10. 6·58671.
11. 309·1044924.
12. ·0728.
13. 1872.
14. 4738 qrs. 2 bus.
    2 pk. 1 gl. 3 qts.
    1 pt.
15. 7*s.*
16. £86 19*s.* 6*d.*
17. £13568 16*s.* $5\frac{1}{4}$*d.*
18. $6\frac{197}{240}$.
19. $9\frac{161}{171}$.
20. $3\frac{2}{21}$.
21. $\frac{5}{12}$.
22. 6954·356071.
23. 12·9137.
24. ·07115951800475.
25. $2{\cdot}3429\dot{9}2\dot{5}$.
26. ·525.
27. [illegible] mi. 7 fur.
    18 po. 2 y. 2 in.
28. 96.
29. £25 17*s.* $3\frac{1}{2}$*d.*
30. 7 years.
31. $3\frac{119}{198}$.
32. [illegible]
33. $\frac{1}{36}$.

34. $2\frac{2}{23}$.
35. 1872·88.
36. 781·568 oz.
37. 41·2521346675.
38. ·0563.
39. 63 lbs.

LVIII.

1. 695 lbs. 4 oz. 3 dwts. 9 grs.
2. 1*s.* $10\frac{1}{2}$*d.*
3. £8 14*s.* 2*d.*
4. £250 2*s.* 6*d.*
5. $\frac{59}{64}$.
6. $1\frac{11}{27}$.
7. $\frac{8}{17}$.
8. $\frac{7}{130}$.
9. 407·75581$\dot{2}$.
10. 33·934899.
11. 160504·9226.
12. ·1144.
13. £16 0*s.* 6*d.*
14. 71 mi. 4 f. 14 po. 5 y. 1 ft. 2 in.
15. 144 feet.
16. £26 17*s.* $8\frac{1}{4}$*d.*
17. £11 18*s.* 6*d.*
18. $16\frac{283}{330}$.
19. $\frac{131}{180}$.
20. $\frac{265}{6288}$.
21. 6.
22. 8004·709485.
23. 11·57294.
24. 1460·15448.
25. 102·204.
26. ·002$\dot{7}$.
27. $77591\frac{1}{4}$ s. ft.
28. 176 a. 1 r.
29. £5 1*s.*
30. 8 years.
31. $19\frac{7}{12}$.
32. $7\frac{37}{39}$.
33. 1.
34. $20\frac{1}{40}$.
35. 20135·2652434.
36. ·005899.
37. 21·812076.
38. 13762844·$\dot{4}$.
39. 1·43$\dot{1}\dot{8}$.

LIX.

1. 27 tons 4 cwt. 2 qrs. 16 lbs.
2. 1012 lbs.
3. £1467 17*s.* $2\frac{1}{4}$*d.*
4. £22 7*s.* 2*d.*
5. $1\frac{79}{120}$.
6. $7\frac{3}{8}$.
7. $9\frac{1}{2}$.
8. $4\frac{1}{4}$.
9. 70·621588.
10. 48·112.
11. 256·5148683.
12. 6676.
13. 35164·8.
14. 82703 s. yds. 4 ft. 72 in.
15. 3.
16. £3 14*s.* 9*d.*
17. £1670 8*s.* 5*d.*
18. $3\frac{5}{8}$.
19. $1\frac{74}{117}$.
20. $\frac{1}{2}$.
21. $\frac{6}{13}$.
22. 945·70522.
23. 29·2996.
24. 34·342295.
25. ·099.
26. £3 1*s.* 8*d.*
27. 3779 cub. yds. 7 ft. 561 in.
28. 16.
29. £4 17*s.* $10\frac{1}{2}$*d.*
30. 7 years.
31. $1\frac{21}{40}$.
32. $3\frac{5}{24}$.
33. $\frac{5}{36}$.
34. 9.
35. 500·815913.
36. 2·206.
37. 6·586216.
38. ·0862.
39. ·001041$\dot{6}$.

LX.

1. 4 lbs. 1 oz. 2 dwts.
2. £42.
3. £2 8*s.* 9*d.*
4. £848 2*s.*
5. $4\frac{77}{80}$.
6. $2\frac{3}{14}$.
7. 12.
8. $\frac{8}{15}$.
9. 910·6483.
10. 62·91521.
11. 81·2469414.
12. ·1334...
13. 88345·6.
14. 15724692.
15. £54 11*s.* $0\frac{1}{2}$*d.*
16. £336 19*s.* $6\frac{1}{4}$*d.*

17. £5455 11*s.* 9*d.*
18. $7\frac{17}{28}$.
19. $2\frac{13}{55}$.
20. 6.
21. $\frac{7}{32}$.
22. 927·08415.
23. 176·85121.
24. ·004399455.
25. ·0016.
26. 68·25.
27. 112112.
28. 4.
29. £11822146 3*s.* 6*d.*
30. $3\frac{1}{4}$.
31. $\frac{14}{15}$.
32. $10\frac{7}{20}$.
33. 12.
34. $4\frac{1}{2}$.
35. 1041·627323.
36. 6·8346.
37. 98·625.
38. ·071.
39. ·134.

LXI.

1. 131 lbs. 7 oz. 18 dwts. 20 grs.
2. $11\frac{1}{4}$*d.*
3. £25 11*s.*
4. £46 11*s.* $10\frac{1}{2}$*d.*
5. $6\frac{7}{24}$.
6. $4\frac{20}{77}$.
7. $24\frac{9}{59}$.
8. 68.
9. 523·29603.
10. ·291385.
11. 221086.
12. ·0042.
13. 15·5.
14. 190 c. y. 2 f. 1 in.
15. 75.
16. £4688 8*s.* 9*d.*
17. £7588 4*s.* 6*d.*
18. $2\frac{58}{143}$.
19. $11\frac{122}{153}$.
20. 20.
21. 86.
22. 8642·9358.
23. 529·375.
24. ·1029304113.
25. 7·8689.
26. 1722.
27. 5377200.
28. $5\frac{5}{6}$ oz.
29. £78760 10*s.*
30. $5\frac{1}{4}$.
31. $1\frac{6}{11}$.
32. $48\frac{19}{22}$.
33. $\frac{3}{5}$.
34. $\frac{274}{361}$.
35. 180910·3732215.
36. 488·784.
37. 496·9297245.
38. 1·45005.
39. 8401·4.

LXII.

1. 21 tons 3 cwt. 22 lbs. 4 oz.
2. £40 18*s.* $7\frac{1}{2}$*d.*
3. £87 7*s.* 6*d.*
4. £82 9*s.*
5. $\frac{119}{120}$.
6. $17\frac{7}{8}$.
7. $\frac{4}{7}$.
8. 4.
9. 64·024003.
10. ·42067.
11. ·1164408.
12. ·2062.
13. $\cdot161458\dot{3}$.
14. 203 a. 2 r. 13 po. 10 y. 7 f. 108 in.
15. $5\frac{1}{3}$.
16. £1887 10*s.* $7\frac{1}{2}$*d.*
17. £8581 5*s.* 4*d.*
18. $4\frac{2}{5}$.
19. $1\frac{17}{18}$.
20. $\frac{5}{48}$.
21. 6.
22. 230·24285.
23. 9·8202.
24. ·343544625.
25. 148·2799.
26. £1 14*s.* 2*d.*
27. 168 lbs. 11 oz. 17 dwts. 8 grs.
28. $5\frac{1}{4}$ oz.
29. £835 5*s.* 10*d.*
30. 3 years.
31. $5\frac{15}{16}$.
32. $\frac{21}{22}$.
33. $1\frac{9}{40}$.
34. $\frac{1}{5}$.
35. 1003·791987.
36. 899·345.
37. 2·0325984.
38. 5·9178.
39. $\cdot\dot{4}$.

LXIII.

1. 431700.
2. £2 5*s.* 10*d.*
3. £579 11*s.*
4. £10 5*s.* $1\frac{1}{4}$*d.*
5. $16\frac{137}{360}$.
6. $4\frac{41}{44}$.
7. $2\frac{1}{2}$.
8. $\frac{1}{26}$.
9. 1018·80891.
10. 123·3034072.
11. 4·304463.
12. ·1435.
13. 133·584.
14. 1 lb. 12 dwts. 7 grs.
15. 1*s.* 10*d.*
16. £36 4*s.* 6*d.*
17. £1811 18*s.* 6*d.*
18. $8\frac{127}{180}$.
19. $4\frac{447}{455}$.
20. $2\frac{2}{3}$.
21. $9\frac{9}{10}$.
22. 4366·437556.
23. 14·5652781.
24. 4873·788.
25. 740·9.
26. ·01875.
27. 43 a. 2 r. 25 po. 12 y. 3 f. 109 in.
28. $28\frac{1}{2}$ hours.
29. 3*s.* $7\frac{3}{4}$*d.*
30. $9\frac{1}{2}$.
31. $18\frac{7}{18}$.
32. $10\frac{379}{385}$.
33. $24\frac{24}{55}$.
34. $1\frac{1}{3}$.
35. 2115·546234.
36. ·9987.
37. ·00136596977.
38. 99·6317.
39. 423·84.

LXIV.

1. 180829.
2. £9 4*s.* $10\frac{1}{2}$*d.*
3. £30613 5*s.* 6*d.*
4. £109 15*s.* $6\frac{3}{5}$*d.*
5. $5\frac{173}{180}$.
6. $2\frac{29}{40}$.
7. $142\frac{7}{8}$.
8. $\frac{705}{776}$.
9. 439·8067.
10. 7·37966.
11. 680·33892.
12. 6·5451.
13. 6*s.* $8\frac{1}{4}$*d.*
14. 512 m. 4 f. 33 p. 2 yds. 1 ft. 3 in.
15. 10*s.*
16. £36 10*s.* $2\frac{1}{4}$*d.*
17. £491 5*s.* $10\frac{1}{2}$*d.*
18. $6\frac{34}{63}$.
19. $5\frac{19}{91}$.
20. 2.
21. $13\frac{20}{27}$.
22. 4255·13424.
23. 61·90348.
24. ·0488976.
25. ·00149.
26. $1·9116319\dot{4}$.
27. 62857296.
28. 1320.
29. £34 10*s.* $7\frac{1}{2}$*d.*
30. $3\frac{1}{2}$ years.
31. $15\frac{5}{112}$.
32. $1\frac{19}{60}$.
33. $\frac{99}{410}$.
34. $\frac{33}{37}$.
35. 375·1096.
36. 84·2307.
37. 43·0782.
38. ·04375.
39. $·597\dot{2}$.

LXV.

1. 10 tons 7 cwt. 3 qrs. 12 lbs. 3 oz.
2. 5 cwt. 12 lbs.
3. £1162 18*s.* $7\frac{1}{2}$*d.*
4. £2812 10*s.*
5. $10\frac{31}{210}$.
6. $\frac{111}{143}$.
7. $5\frac{5}{6}$.
8. 18.
9. 6158·32263.
10. ·907869.
11. 65·75081373.
12. 654·433...
13. ·414.
14. 1992.
15. £4 14*s.*
16. £3337 13*s.* $3\frac{3}{4}$*d.*
17. £4251 10*s.* 6·72*d.*
18. $10\frac{301}{432}$.
19. $\frac{15}{221}$.
20. $2\frac{1}{2}$.
21. $\frac{1}{36}$.
22. 656·54031.
23. 123·695.

24. ·032078422.
25. ·0575.
26. 302·5 sq. yds.
27. 119880.
28. 5.
29. £884 9*s*. $4\frac{1}{2}$*d*.
30. $2\frac{1}{2}$.
31. $3\frac{131}{1092}$.
32. $2\frac{9}{11}$.
33. $\frac{7}{88}$.
34. $24\frac{1}{2}$.
35. 1811·264.
36. 22·34.
37. ·72623631.
38. ·00572.
39. ·225.

LXVI.

1. 36229680.
2. £15 5*s*. 3*d*.
3. £1835 2*s*. 2*d*.
4. £154 18*s*. 3*d*.
5. $7\frac{1}{3}$.
6. $1\frac{31}{96}$.
7. $\frac{72}{115}$.
8. $\frac{11}{54}$.
9. 419·54232.
10. 105·189.
11. 3·258585.
12. 6·64152.
13. 5846·4.
14. 120 lbs. 4 oz. 15 dwt. 7 grs.
15. 7 cwt. 3 qrs. 11 lbs.
16. £400 9*s*. 2*d*.
17. £8695 17*s*. 10*d*.
18. $5\frac{31}{36}$.
19. $\frac{13}{24}$.
20. 60.
21. $1\frac{1}{14}$.
22. 1134·36035.
23. 1·073.
24. 25548·9922.
25. ·582.
26. 16·176.
27. 16746.
28. 10.
29. £839 14*s*. $4\frac{1}{2}$*d*.
30. $4\frac{3}{4}$ years.
31. $5\frac{69}{200}$.
32. $\frac{3}{5}$.
33. 1.
34. $3\frac{1}{2}$.
35. 5791·71.
36. 65·062 pints.
37. ·00010275.
38. 31·8.
39. ·002.

LXVII.

1. 13056.
2. 103 tons 4 cwt.
3. £36 10*s*. $10\frac{1}{2}$*d*.
4. £2576 10*s*. $10\frac{1}{5}$*d*.
5. $9\frac{313}{720}$.
6. $10\frac{91}{340}$.
7. $\frac{1}{2}$.
8. 6.
9. 1233·13993.
10. 12·22564.
11. 14·3706927.
12. ·28.
13. ·0015625.
14. $17248\frac{1}{2}$.
15. 12*s*.
16. £217 3*s*. $9\frac{1}{2}$*d*.
17. 3193 2*s*. 1·7952*d*.
18. $16\frac{277}{1100}$.
19. $3\frac{241}{420}$.
20. 1.
21. $2\frac{59}{97}$.
22. 709·611.
23. 11·3255.
24. ·067374.
25. ·00585.
26. 6·93756.
27. 15 tons 13 cwt. 3 qrs. 15 lbs. 13 oz.
28. £186 18*s*. $5\frac{1}{4}$*d*.
29. £4549 19*s*. $5\frac{3}{4}$*d*.
30. $4\frac{1}{2}$.
31. $8\frac{7}{270}$.
32. $7\frac{23}{60}$.
33. $\frac{5}{6}$.
34. $\frac{1}{25}$.
35. 608·49863.
36. 400·2211.
37. ·00014606648.
38. 8800.
39. 3446·352.

LXVIII.

1. 40 lbs. 8 oz. 13 dwts. 11 grs.
2. £2 17*s*. 6*d*.
3. £122 3*s*.
4. £257 5*s*. 3*d*.

5. $8\frac{11}{19}$.
6. $\frac{53}{72}$.
7. $1\frac{10}{11}$.
8. $2\frac{2}{11}$.
9. 5511·14976.
10. 31·463839.
11. 9·844635.
12. 60·917.
13. ·16953125.
14. 1686.
15. 3*s.* 4*d.*
16. £30 13*s.* 6*d.*
17. £4216 12*s.* 2*d.*
18. $7\frac{7}{16}$.
19. $\frac{109}{300}$.
20. $5\frac{5}{8}$.
21. $1\frac{5}{14}$.
22. 212·32874.
23. 1·4419.
24. 340·8646095.
25. 111.
26. 81·84.
27. 1779426.
28. 5.
29. £21579 15*s.*
30. 2 years.
31. $8\frac{35}{36}$.
32. $\frac{17}{144}$.
33. $17\frac{17}{20}$.
34. $\frac{8}{309}$.
35. 3535·62.
36. 1256·64.
37. ·000009588.
38. ·072.
39. 699·84.

LXIX.

1. 139 tons 12 cwt. 3 qr. 24 lb. 9 oz.
2. £585 1*s.* $4\frac{1}{2}$.
3. £224 7*s.* $10\frac{1}{2}$*d.*
4. £105 0*s.* $4\frac{1}{2}$*d.*
5. 12.
6. $2\frac{19}{24}$.
7. $2\frac{4}{19}$.
8. $17\frac{9}{23}$.
9. 55004·332.
10: 26·89886.
11. 7367·17818.
12. 176·48.
13. ·225.
14. 806 mi. 7 f. 32 po. 1 yd. 2 ft. 7 in.
15. £319.
16. £11 13*s.*
17. £1228 7*s.*
18. $3\frac{267}{550}$.
19. $11\frac{4}{153}$.
20. $3\frac{8}{105}$.
21. $\frac{27}{500}$.
22. 14·8105206.
23. 43·6899957.
24. 810·4704.
25. 181·775....
26. 84 lbs. 4 oz.
27. 5 w. 4 d. 19 h. 45 m. 7 s.
28. $4\frac{1}{16}$ lbs.
29. £8 7*s.* 6*d.*
30. $50\frac{2}{3}$ years.
31. $55\frac{28}{75}$.
32. $13\frac{41}{48}$.
33. $10\frac{14}{19}$.
34. 9.
35. 6750·384773.
36. ·0559491.
37. 10709·7432.
38. ·2205$\dot{7}$.
39. ·1875.

LXX.

1. 416 lbs. 9 oz. 1 dwt. 16 gr.
2. 5*s.* $7\frac{1}{2}$*d.*
3. £25 18*s.* $0\frac{1}{4}$*d.*
4. £146 14*s.*
5. $\frac{6}{7}$.
6. $5\frac{13}{70}$.
7. $\frac{61}{90}$.
8. $\frac{28}{401}$.
9. 5108·707283.
10. 37·932239.
11. 15761·95818.
12. 1376·28$\dot{4}$.
13. ·715$\dot{9}\dot{0}$.
14. 101 m. 2 f. 34 p. 2 yds. 10 in.
15. £240.
16. £471 11*s.* 3*d.*
17. £252 17*s.* 11*d.*
18. $1\frac{271}{330}$.
19. $4\frac{551}{1200}$.
20. $\frac{1}{1250}$.
21. 12.
22. 3116·003675.
23. 17·40994.
24. 133·03554.
25. 9808·979...
26. 2 lbs. 2 oz. 11 dwts. 1·728 gr.

27. $20\dot{7}360$.
28. 4.
29. £12 7*s*. $2\frac{1}{4}$*d*.
30. $7\frac{1}{2}$ years.
31. $10\frac{83}{800}$.
32. $96\frac{1}{2}$.
33. $1\frac{5}{63}$.
34. $91\frac{7}{33}$.
35. 305·32666.
36. ·01909099.
37. 16·005825.
38. $4{\cdot}407\dot{5}$.
39. ·09375.

LXXI.

1. 373 tons 17 cwt. 3 qrs. 24 lbs. 8 oz.
2. £27 19*s*.
3. £381 16*s*. 5*d*.
4. £50 12*s*. 9*d*.
5. $1\frac{27}{44}$.
6. $96\frac{1}{2}$.
7. $\frac{49}{180}$.
8. $\frac{14}{101}$.
9. 476·447224719.
10. 373·0099.
11. $423784{\cdot}4\dot{3}$.
12. $2752568{\cdot}\dot{8}$.
13. $\cdot 5208\dot{3}$.
14. 98 mi. 38 po. 5 yds. 2 ft. 2 in.
15. £2700.
16. £1522 10*s*. $11\frac{1}{4}$*d*.
17. £1360 9*s*. 9·3504*d*.
18. $4\frac{73}{80}$.
19. $4\frac{157}{400}$.
20. $\frac{1}{66}$.
21. 18.
22. 83110·003395.
23. ·946994.
24. 90·96156.
25. ·0041.
26. ·028.
27. 186636.
28. 3 lbs.
29. £12 18*s*. $1\frac{1}{2}$*d*.
30. $7\frac{1}{2}$ years.
31. $7\frac{94}{105}$.
32. $1\frac{5}{8}$.
33. 1.
34. 5.
35. 20166·0228203.
36. 4320·99900099.
37. ·0016000919.
38. $\cdot 11136\dot{1}$.
39. 161.

LXXII.

1. 156572.
2. £3 19*s*. $10\frac{1}{2}$*d*.
3. £17 14*s*. $4\frac{1}{2}$*d*.
4. £6.
5. $6\frac{1}{30}$.
6. $1\frac{5}{36}$.
7. 18.
8. $\frac{16}{45}$.
9. 999·0101643.
10. 34·83145.
11. 120987·2.
12. ·21603.
13. 3 ac. 3 r. 14 po.
14. 321 qrs. 5 bus. 3 pk. 1 qt. 1 pt.
15. 17.
16. £511 3*s*. $8\frac{3}{4}$*d*.
17. £9584 6*s*. $6\frac{3}{8}$*d*.
18. $5\frac{13}{51}$.
19. $\frac{24}{117}$.
20. 2.
21. 14.
22. 634·898367.
23. 26·31772.
24. ·2163294..
25. 6·056.
26. ·01875.
27. £2.
28. 2122.
29. The latter, £136762 10*s*.
30. $\frac{111317}{416625}$, 32*s*. $0\frac{3}{4}$*d*.
31. $11 \times 2^6 \times 3^4 \times 13^2 \times 5 \times 7^2$.
32. 150 lbs.

LXXIII.

1. 198695.
2. $414\frac{78}{113}$.
3. £444 16*s*. 8*d*.
4. £6 8*s*.
5. $10\frac{13}{96}$.
6. $3\frac{3}{4}$.
7. $8\frac{7}{16}$.
8. $2\frac{13}{16}$.
9. 7975·027604.
10. 463·34305.
11. 162592·5.
12. ·0484...
13. 4919·86.
14. 44 m. 7 f. 13 po. 3 yds. 6 in.

15. $6\frac{7}{30}$ days.
16. £1390 17*s.* $8\frac{1}{2}$*d.*
17. £859 11*s.* 5*d.*
18. $22\frac{37}{40}$.
19. $6\frac{13}{56}$.
20. $\frac{5}{12}$.
21. $\frac{488}{679}$.
22. 689·948969.
23. 381·68388.
24. ·510592.
25. 24100.
26. ·02875.
27. 125·146, $7\cdot\dot{8}$.
28. $2\frac{1}{2}$.
29. A £162, B £324, C £405, D £486, E £648.
30. 1*s.* 3*d.*
31. 50 per cent.
32. $112\frac{1}{2}$ days.

LXXIV.

1. 38 tons 4 cwt. 3 qr. 16 lb. 7 oz.
2. 6.
3. £4567 14*s.* $9\frac{3}{4}$*d.*
4. £43 19*s.* $4\frac{1}{2}$*d.*
5. $15\frac{122}{225}$.
6. $\frac{19}{21}$.
7. $\frac{18}{23}$.
8. $\frac{3}{67}$.
9. 7831·557604.
10. 465·91874.
11. 2·475727.
12. 174·3170.
13. $\cdot 024\dot{7}93388429\dot{9}$.
14. $23787\frac{1}{2}$.
15. £1 2*s.* 9*d.*
16. £9 7*s.* 5*d.*
17. £4104 18*s.* $9\frac{9}{50}$*d.*
18. $12\frac{1}{72}$.
19. $4\frac{3}{4}$.
20. $2\frac{6}{7}$.
21. $2\frac{1}{2}$.
22. 10125·6218832.
23. 8256·21935.
24. 31144·896.
25. 70·4.
26. 5 oz. 10 dwts. 3·552 grs.
27. 10·043, 234.
28. £584 6*s.* 8*d.*
29. $\frac{5}{8}$.
30. 28 days.
31. Tuesday, Monday.

LXXV.

1. $7\frac{113}{160}$.
2. $4\frac{62}{63}$.
3. $24\frac{27}{88}$.
4. $1\frac{40}{861}$.
5. 137·09806.
6. 25·924817.
7. ·7965216.
8. 7·4.
9. $\cdot 01\dot{6}$.
10. $15\frac{5}{21}$.
11. $6\frac{1}{30}$.
12. $2\frac{38}{45}$.
13. $1\frac{120}{161}$.
14. 25·884.
15. 1·725.
16. ·12888.
17. 667·6.
18. ·0335.
19. $23349\frac{1}{2}$.
20. £220 13*s.* 4*d.*
21. £5688 17*s.* $4\frac{3}{4}$*d.*
22. £369 12*s.*
23. 28503 hhd. 51 gal. 2 qt. 1 pt.
24. $4\frac{4}{5}$ lbs.
25. £5 18*s.* 1*d.*
26. £2755 2*s.* $11\frac{2}{3}$*d.*
27. £4 1*s.* 8*d.*
28. 396·6438.
29. £17135, £147 4*s.*
30. Side of base, 278 in., depth, $69\frac{1}{2}$ in.
31. Friday, 26th June, A.D. 1761.

LXXVI.

1. $9\frac{183}{1040}$.
2. $2\frac{57}{68}$.
3. $\frac{45}{236}$.
4. $\frac{3}{4}$.
5. 4753·031255.
6. 97·388833.
7. 602·3176.
8. 39·65325.
9. ·0375.
10. $22\frac{79}{280}$.
11. $65\frac{37}{40}$.
12. 18.
13. $1\frac{7}{12}$.
14. 912·96 feet.

15. 4 days 10 hrs. 52 min. 48 sec.
16. 27·602925.
17. 96·3836.
18. ·0958$\dot{3}$.
19. 93168.
20. £6 13*s.* 0$\frac{876}{1439}$*d.*
21. £518 6*s.* 1$\frac{1}{4}$*d.*
22. £780.
23. 124 a. 2 r. 35 p. 1 y. 4 ft. 36 in.
24. 2.
25. £168 4*s.* 11$\frac{1}{16}$*d.*
26. 4$\frac{3}{4}$ years.
27. 3*s.* 3*d.*
28. 7 feet 8 inches.
29. 61·5819...
30. 4*s.* 4$\frac{1}{2}$*d.*

LXXVII.

1. 5$\frac{97}{168}$.
2. 2$\frac{161}{171}$.
3. $\frac{15}{16}$.
4. $\frac{6}{7}$.
5. 83·50058.
6. 18·244546.
7. 1·010016.
8. 670.
9. ·1$\dot{1}$9047$\dot{6}$.
10. 4$\frac{203}{360}$.
11. 3$\frac{359}{380}$.
12. $\frac{5}{132}$.
13. 1$\frac{7}{247}$.
14. 202·68.
15. 35 min. 42 sec.
16. ·1055024.
17. ·00111.
18. ·0078125.
19. 63283.
20. 40.
21. £7833 3*s.* 7$\frac{1}{2}$*d.*
22. £3729 7*s.* 6*d.*
23. 23 w. 5 d. 6 h. 32 min. 5 sec.
24. 15$\frac{3}{4}$ oz.
25. £58 10*s.* 9*d.*
26. 2$\frac{1}{2}$.
27. 8004, 3·5.
28. 29393, $\frac{379}{461189}$.
29. £1000.
30. £22 13*s.* 9*d.*, ·720$\dot{2}$3809$\dot{5}$.

LXXVIII.

1. 7$\frac{1}{180}$.
2. 2$\frac{13}{54}$.
3. 27.
4. 4$\frac{1}{2}$.
5. 1669·94885.
6. 164·3248.
7. 31·0539544.
8. 6196.
9. ·05.
10. 10$\frac{11}{28}$.
11. 2$\frac{169}{180}$.
12. 14$\frac{5}{8}$.
13. 3$\frac{2}{7}$.
14. 2603·04.
15. 1457·97 grains.
16. 1356·048.
17. ·000104.
18. 3·4992.
19. 6086.
20. 43 cwt. 3 qrs. 14 lbs.
21. £3791 11*s.* 3$\frac{1}{4}$*d.*
22. £660.
23. 23 m. 1 f. 18 p. 4 yds. 2 ft. 3 in.
24. £1 1*s.* 4*d.*
25. £25 2*s.* 3$\frac{1}{2}$*d.*
26. £4466 6*s.* 2$\frac{2}{5}$*d.*
27. 1$\frac{13}{47}$ days, A $\frac{20}{47}$, B $\frac{15}{47}$, C $\frac{12}{47}$.
28. £900, £1120, £750.
29. 1633$\frac{1}{2}$ tons.
30. ·06561, 3·43.
31. 80 per cent. loss.

LXXIX.

1. 11$\frac{67}{420}$.
2. 1$\frac{71}{90}$.
3. 13$\frac{1}{2}$.
4. 8$\frac{8}{45}$.
5. 899·24467.
6. 701·1381.
7. 3·585207.
8. 48·295.
9. ·009375.
10. 7$\frac{11}{30}$.
11. $\frac{179}{360}$.
12. 112.
13. $\frac{94}{109}$.
14. 48·416.
15. 2 oz. 6 dwts. 4·32 grs.
16. 26638·694.
17. ·00329375.
18. 66·30172.
19. 185680.
20. 1 gallon.
21. £72071 3*s.* 3$\frac{3}{4}$*d.*
22. 8 years.

23. 14 m. 7 f. 19 p. 2 yds. 2 ft. 7 in.
24. 90.
25. £38 16*s.* 9*d.*
26. £4371 0*s.* 7*d.*
27. 90·909, ·074.
28. 6336000, 176785$\frac{5}{7}$ tons.
29. 120 days, 11 hrs. 46 min., 12 hrs. 16 min.
30. $1\frac{1}{10}$ hours.

LXXX.

1. Nine thousand million seven hundred and thirty-five thousand and six.
2. 5015005.
3. 31280.
4. 1512632327.
5. £108920 11*s.* 6*d.*
6. £785744 14*s.* $6\frac{3}{4}$*d.*
7. 5707130518 52.
8. £648467 16*s.* 11*d.*
9. £12447 5*s.* $8\frac{3}{4}$*d.*
10. £375623 17*s.* $11\frac{3}{4}$*d.*
11. 85296.
12. £43 2*s.* $7\frac{1}{4}$*d.*
13. £2045 4*s.* $7\frac{1}{2}$*d.*
14. £326.
15. £2835.
16. 59 a. 14 po. 13 y. 4 ft. 120 in.
17. $8\frac{13}{24}$.
18. $1\frac{69}{80}$.
19. $1\frac{27}{112}$.
20. $25\frac{38}{85}$.
21. 1150·74.
22. 239·97 dwts.
23. ·0886212.
24. ·003125.
25. 130.
26. ·21875.
27. 30.
28. 9*s.* $4\frac{1}{2}$*d.*, 11·71875 francs.
29. 729 yards.
30. 3 miles an hour.

LXXXI.

1. Eight hundred and six million thirty thousand and seventy-five.
2. 200011050.
3. 60013090.
4. 2017881299.
5. £216391 7*s.* $2\frac{3}{4}$*d.*
6. £162656 15*s.* $8\frac{3}{4}$*d.*
7. 26008571061.
8. £17579.
9. £26843 3*s.* $2\frac{1}{2}$*d.*
10. £368 12*s.* $9\frac{1}{4}$*d.*
11. 13080.
12. $3\frac{3}{4}$*d.*
13. £4414 19*s.* $0\frac{3}{4}$*d.*
14. £409 10*s.*
15. 26 days.
16. $4\frac{1}{4}$ years.
17. $10\frac{553}{660}$.
18. $3\frac{213}{440}$.
19. 1.
20. $1\frac{5}{14}$.
21. 1659·84586.
22. 21·28148.
23. 1·09539232.
24. 1625.
25. ·00024.
26. 894·6448.
27. $\frac{432}{19}$, 7·8.
28. $\frac{25}{162}$.
29. £126, $3\frac{29}{57}$ per cent.
30. A : B : : 40 : 53.

LXXXII.

1. £586 2*s.* $0\frac{24}{59}$*d.*
2. £534 6*s.* 6*d.*
3. £2 14*s.* $5\frac{61}{82}$*d.*
4. 5 yds. 4 in.
5. £711 5*s.* $5\frac{5}{11}$*d.*
6. £31 5*s.*
7. 174 cub. ft. $617\frac{47}{72}$ cub. in.
8. £5 5*s.*, £6 17*s.* $4\frac{47}{480}$*d.*
9. 33089 : 31680.
10. 72°·1.
11. £18 15*s.*
12. 75 days.
13. £8000000.
14. £11 5*s.* gain.

LXXXIII.

1. ·632, ·0016.
2. £12 15*s.*

3. 50 tons 12 cwt. 3 qrs. 9 lbs. 8 oz., 32410 tons 14 cwt. 1 qr. 4 lbs.
4. $2\frac{14}{29}$.
5. 45 miles.
6. 26722·36.
7. 812 cub. ft. $1551\frac{1}{2}$ cub. in.
8. $5\frac{1}{68}$ per cent. gain.
9. 196 yds. 2 ft. 3·863424 in.
10. £1835 11*s*. $7\frac{143}{163}$*d*. £8 16*s*. $8\frac{40}{163}$*d*.
11. 9450 links.
12. 14*s*. 9·876*d*.
13. ·7182819.
14. £242914 19*s*. $7\frac{35}{247}$*d*.

LXXXIV.

1. ·001.
2. 8·495.
   8 chs. 4 chainlets 9 links 5 linklets.
3. 18·4325.
4. 11 hours.
5. 80 loss.
6. 450 cub. ft. $766\frac{17}{24}$ cub. in.
7. £4 15*s*. $2\frac{6}{7}$*d*., $3\frac{1}{4}$.
8. 914 yds. 1 ft. 7 in.
9. 108·5.
10. 37 yds. 1 ft. $7\frac{1}{9}$ in.
11. 24780·8.
12. 1000.
13. 62·7.

LXXXV.

1. £653 4*s*. $4\frac{52}{59}$*d*.
2. £937 13*s*. 2*d*.
3. $29\frac{7}{10}$.
4. £2 9*s*. $3\frac{1}{9}$*d*.
5. £375.
6. £3 5*s*. 4*d*.
7. 184·06 yards.
8. 125 s. ft. $83\frac{125}{144}$ s. in.
9. £31 5*s*.
10. 25 ft. 4 in.
11. 8 ft., 13·856 ft., 64 sq. ft.
12. 10 h. 8 m. $46\frac{7}{48}$ s.
13. March 26, 1790.
14. $\frac{169}{16}$, $\frac{13}{4}=3{\cdot}25$.
15. 1609·3, 1093 y. 1 ft. 11 in.

LXXXVI.

1. $\cdot 0955\dot{7}53246\dot{}$.
2. £120, £3 10*s*. $8\frac{208}{679}$*d*.
3. £11 15*s*. $2\frac{2}{5}$*d*.
4. 750.
5. 56 hours.
6. 68 c. y. 26 c. ft. 1064 c. in.
7. £16 2*s*. $10\frac{173}{400}$*d*.
8. $\cdot 08\dot{3}$, ·04.
9. 2·2239.
10. 10 in.
11. 6·339 in.
12. $38\frac{2}{11}$ m. past 7.
13. $25\frac{3}{4}$ yd., $30\frac{9}{10}$ y.
14. £125.
15. ·24.

LXXXVII.

1. 26·004, 4·06.
2. £93 11*s*. $3\frac{5}{8}$*d*.
3. 10·189875.
4. £3 15*s*. $3\frac{9}{17}$*d*. gain.
5. 100 a. 3 r. 17 po.
6. £29 10*s*. $1\frac{7}{17}$*d*. increase.
7. £950400.
8. ·0000386556...
9. 32, £115 4*s*.
10. 303 c. ft. 1113 c. in.
11. £5 1*s*. $11\frac{6}{11}$*d*., £13 1*s*.
12. $189\frac{1}{27}$.

LXXXVIII.

1. 38.
2. 62569, $\frac{177}{29}$.
3. £7877 10*s*.
4. 5 per cent. gain.
5. £9 12*s*. $7\frac{1}{9}$*d*.
6. 3 ch. 61·36 links, 79 y. 1 ft. 6 in. nearly.
7. 3 yds. 2 ft. 6 in.
8. 92 c. ft. $638\frac{7}{12}$ c. in

9. £17135,
£147 4*s.*
10. £85.
11. 63·53...
12. $\frac{379}{11 \times 13 \times 17 \times 19}$
·000379.
13. $14\frac{7}{12}$,
7 to 5.
14. 7 m. 12 s. past 11.

LXXXIX.

2. 105 inches.
3. £1820.
4. 164 yds. $2\frac{14}{15}$ ft.
5. ·0071875.
6. 170 cubic feet
$542\frac{7}{9}$ cub. in.
7. £1300, £4 loss.
8. 1·0490734.
9. £1247 10*s.*
10. £7 per cwt.
11. 120 days,
16 m. past 2,
14 m. before 2.
12. 50.
13. $7\frac{1}{2}$ feet.

XC.

1. ·01849, ·62996.
2. 360360.
3. $20\frac{19}{73}$.
4. 1250.
5. $1\frac{41}{91}$, $\frac{12}{29}$.
6. £600.
7. £12.
8. $6\frac{36}{345}$.
9. A, £23 5*s.* 9*d.*,
B, £30 14*s.* 3*d.*
10. 73 c. y. 8 c ft.
98 cub. in.
11. $11\frac{2}{3}$ days.
12. 124 fathoms.
13. $66\frac{2}{3}$ yards from A's corner. A passed his corner 3 times, B 2 times.
14. 102.
15. A, £18400, B,
£12266 13*s.* 4*d.*

XCI.

1. 3522178,
3998936616.
2. 14 d. 7 h. 11 m.
17 s., 2674 d.
9 min. 59 sec.
3. $\frac{11}{26}$.
4. 3738.
5. 1100 ft. per sec.
6. $44\cdot\dot{5}789473684$
$2105263\dot{3}$.
7. 4374.
8. 11 cubic feet
$1207\frac{559}{576}$ c. in.
9. 34 ft. 6 in.
10. £1 per share.
11. £10.
12. $77\frac{1}{2}$.
13. 3.
14. B wins by 50 y.
in $4\frac{3}{4}$ min.

XCII.

1. 3527160, $6\frac{401}{920}$.
2. $9\frac{112}{113}$, ·26457.
3. £12000.
4. £971 11*s.* $3\frac{113}{122}$*d.*
5. 392 cubic feet
$244\frac{2}{9}$ cub. in.
6. $25\frac{11}{19}$ francs.
7. 148 feet.
8. $\frac{541}{16650}$, $7\frac{443}{555}$.
9. £26 13*s.* 4*d.*
10. 8310 yards.
11. $30\frac{5}{64}$.
12. $5\frac{173}{180}$ grains.
13. 17609·705.
14. 35·38 oz.

XCIII.

1. $3\cdot22\dot{3}5497\dot{8}$.
2. 603729.
3. 0, $5\frac{5}{24}$.
4. £$899\frac{181}{1081}$.
5. 44989·77...fr.
6. £1330800.
7. £23 loss.
8. $8\frac{1}{3}$ tons.
9. £1126 3*s.* 7*d.*
10. 1728000.
11. A 320′, B 316′.
12. 10 ft. 8 in,
$1\frac{1}{2}$ in.
13. A $261\frac{3}{17}$ days,
B 120 days.

XCIV.

1. 67035024.
One billion one hundred and ten thousand and eleven millions one hundred thousand one hundred and eleven.
$\cdot\dot{8}$.

2. 4·3589, 5·91.

3. 74.

4. $\frac{3773}{4216}$, ·75.

5. The latter.

6. 5 hours 12 min. p.m. Thursday.

7. £11 5*s.* 6·829125*d.*

8. 2.

9. £46 6*s.* $10\frac{775}{896}$*d.*

10. £50350 12*s.* 6*d.*

11. 100 yds. 2 ft.

12. 4 min. 42 sec.

13. $11\frac{71}{308}$ sec.

14. $16\frac{24}{43}$.

XCV.

1. £188 12*s.*

2. $\frac{117}{140}$.

3. £2 17*s.* $6\frac{270}{329}$ gain.

4. 139 yards 5·0478768 in.

5. $14508\frac{1}{8}$.

6. £2590 13*s.* $5\frac{127}{193}$*d.*, $9\frac{63}{193}$.

7. £50 16*s.* $10\frac{19}{23}$*d.*

8. $3{\cdot}539\dot{1}4285\dot{7}$.

9. $\frac{111317}{416625}$, 16*s.* $0{\cdot}37\dot{5}01\dot{3}$*d.*

10. $4\frac{1}{2}$ feet.

11. £7500, £35 5*s.*

12. 12.
$11 \times 2^7 \times 5 \times 3^6 \times 13^2 \times 7^3$

XCVI.

1. 121695.

2. £586 2*s.* $0\frac{24}{59}$*d.*

3. £534 6*s.* 6*d.*

4. 1458.

5. $3\frac{2}{3}$ feet,
22280·61 pounds.

6. £621 13*s.* 4*d.*

7. 34 s. ft. $113\frac{29}{144}$ s. in.

8. $3\frac{1}{8}$.

9. $22{\cdot}2\dot{8}9473684210526315\dot{7}$.

10. 5.

11 $3\frac{11}{15}$.

12. 250 c. ch. 47000 c. links,
6 ch. 30 links.

XCVII.

1. £588 11*s.* $10\frac{46}{47}$*d.*

2. ·031.
1·08 in.

3. 36.

4. £3 0*s.* $1\frac{7}{11}$*d.*

5. 104 c. ft. $1326\frac{13}{24}$ c. in.

6. 320·128...

7. 5 chains 4·625 links,
111 yards ·053 feet.

8. Remainder 6.

9. £3 2*s.* $2\frac{2}{3}$*d.*

10. £65,
He loses £13.

11. 453492, $\frac{3415}{453492}$.

12. 1 kilog. = 2·23608 lbs.

XCVIII.

1. $3\frac{1}{2}$.
2. 98.
3. 10 hrs. 52 min. 48 sec.
4. 30 minutes a day.
5. 1061, $393\frac{5}{13}$.
6. $10\frac{1}{2}$ yds., $3\frac{1}{2}$ yds., 4 yds.
7. $\frac{2}{225}$.
8. A, £501 16*s.* 6*d.*
   B, £250 18*s.* 3*d.*
   C, £83 12*s.* 9*d.*
   D, £20 18*s.* $2\frac{1}{4}$*d.*
9. £2350.
10. $18\frac{3}{4}$ gain.
11. 2037 cub. ft. 189 cub. in.
12. 2 ac. 2 ro. 36 po. nearly.
13. 406 inches.
14. 7 feet.
15. £70.

XCIX.

1. $\frac{395}{3111}$.
2. ·0074, $1\frac{5}{14}$.
3. 4 years.
4. £259 14*s.* 3*d.*
5. £2394 14*s.* $9\frac{1}{8}\frac{23}{21}$*d.*
6. 564.
7. $54\frac{41}{96}$.
8. A man, $1\frac{1}{39}$ lbs.
   A woman, $\frac{10}{13}$ lbs.
   A child, $\frac{20}{39}$ lbs.
9. £3212000.
10. $\frac{8}{77}$ gals.
11. 9,5,1,6,or 5,9,6,1.
12. £100 2*s.* $6\frac{90}{157}$*d.*
13. 98 a. 1 r. 6·82 po. nearly.
14. 137 s. ft.
    127·6974 s. in.
15. 509·208 cub. in.

C.

1. 1·10313131...
   $1\frac{1021}{9900}$.
2. £2080.
3. £31350.
4. 1·8 in.
5. £2010.
6. 358·4.
7. £210 2*s.* 6*d.* loss
8. 3 to 1.
9. 41 c. ft. 432 c. in.
10. 23°, 4·4°.
11. £1109 15*s.*
    4·7712*d.*
12. $11\frac{1}{13}$ min.
13. $21\frac{23}{64}$ gals. water,
    $2\frac{41}{64}$ gals. wine.
    $2\frac{41}{64}$ gals. water,
    $9\frac{23}{64}$ gals. wine.
14. 4318934·235 s.ft.,
    7367·052 ft.
15. 271338349·9904 cub. ft.

CI.

1. 216 acres.
2. 25.
3. $\cdot 79\dot{2}$,
   ·0137741...
4. $\frac{2983}{17}$, 132·5.
5. 200.
6. $2^4 \times 3^3 \times 7 \times 11 \times 13$.
7. $7\cdot\dot{1}3\dot{7}$.
8. £15595 13*s.* 4*d.*
9. £105.
10. 5.
11. £65 10*s.* $4\frac{4}{5}$*d.*
12. 2 in.
13. $\frac{1}{16}$ s. in.
14. 2 hrs. 40 min.
15. 30·5 ft. nearly.

CII.

1. $92\frac{14}{15}$, ·026.
2. £1 5*s.*
3. 494 cub. ft.
   $1596\frac{47}{576}$ cub. in.
4. 36 yds., 24 yds.
5. *t* 376 *eoe.*
6. 25 to 19.
7. $32\frac{8}{11}$ past 12.
8: £700.
9. £30 7*s.* 6*d.*

10. The former, £$\frac{25}{91}$.
11. 1054·2665... sq. yds.
12. 904·7808 sq. in.
13. 2359$\frac{5}{216}$.
14. 53·6°.
15. 22$\frac{1}{2}$ feet.

CIII.

1. 12·025, 15$\frac{1}{8}$.
2. $\frac{37}{48}$.
3. 20$\frac{9473}{34848}$.
4. 6 ft., 4$\frac{1}{2}$ ft., 3 ft.
5. ·8311899...
6. 35$\frac{1}{9}$.
7. Twice; when the winner has run 1$\frac{1}{5}$ miles and 2$\frac{2}{5}$ miles.
8. 3000.
9. £3588 7*s*. 2$\frac{2638}{7577}$*d*.
10. £92 8*s*., £2802 16*s*.
11. 486 sq. yds.
12. 1765·38285 cub. in.
13. 35·5884375 square feet.
14. 18$\frac{1}{3}$°.
15. 6 inches.

CIV.

1. 26·1509125.
2. 18*s*. 9*d*. a gallon.
3. 22$\frac{1}{8}$ years.
4. 5$\frac{85}{123}$ gain.
5. 18495000.
6. £52 10*s*. increase.
7. 88$\frac{6}{13}$.
8. 283$\frac{5}{9}$.

CV.

1. 1541.
2. £58 1*s*. 4*d*.
3. 25313·48.
4. 63$\frac{7}{11}$.
5. £30 1*s*. 6$\frac{3}{4}$*d*.
6. 60.
7. (i.) 1420·479...
4326·5186...
5705·042...
(ii.) 12·403,
37·779,
49·816.

CVI.

1. 457 mi. 6 fur. 17 po. 2 yds. 2 ft. 1 in., 30028130.
2. £839 14*s*. 4$\frac{1}{2}$*d*.
3. £1283 16*s*. 6$\frac{3}{4}$*d*.
4. 208 days.
5. 1.
6. 1240.
7. $\frac{197327}{210025}$, ·93945109...
8. $\frac{9}{91}$, 2 qrs. 17 lbs. 1$\frac{7}{30}$ oz.
9. $\cdot 28\dot{1}\dot{4}$, 10 m. 4 f. 23 y. 2 ft. 3$\frac{9}{25}$ in.
10. £3484 2*s*. 6*d*.
11. £1 15*s*. 6$\frac{9}{25}$*d*.
12. £8 8*s*. 2$\frac{3}{4}$*d*.
13. 3*s*. 6$\frac{466}{827}$*d*.
14. £104 11*s*. 8*d*.
15. A £51 12s., B £81.
16. £12 18*s*. 7$\frac{13}{29}$*d*.
17. 21.
18. 40 oranges, 45 lemons.
19. £8 8*s*. 9*d*.

CVII.

1. 4800477051.
2. £61 7*s*. 10$\frac{31}{32}$*d*.
3. 5$\frac{43}{56}$ per cent.
4. £2541 19*s*. 6$\frac{3546}{3871}$*d*.
5. £21.
6. 4666$\frac{2}{3}$.
7. 8$\frac{13}{14}$.
8. $\frac{4}{17}$.
9. $\frac{1}{7}$.
10. $\cdot 9776\dot{5}\dot{1}$.
11. 50.
12. ·0327838.
13. 25·56 francs.
14. £3408 12*s*.
15. £81.
16. Paris.
17. 280·11...
18. 5$\frac{3}{5}$ months.
19. 7.
20. 300.
21. 54$\frac{6}{11}$ mi. past 4.
38$\frac{2}{11}$ or 5$\frac{5}{11}$ mi. past 4.
21$\frac{9}{11}$ past 4.

CVIII.

1. 2018304000.
2. £10 6*s.* $4\frac{3}{4}$*d.*
3. $97\frac{247}{1016}$.
4. 7699·524.
5. £8 8*s.* $1\frac{7}{8}$*d.*
6. 13·4*s.*
7. 180.
8. $15\frac{5}{13}$.
9. 5.
10. £135 5*s.* $11\frac{831}{839}$*d.*
11. $\frac{67}{80}$.
12. 240.
13. 3108 yards.
14. £833 6*s.* 8*d.*
15. £1407 19*s.* $3\frac{39}{121}$*d.*
    £1877 5*s.* $8\frac{52}{121}$*d.*
    £2393 10*s.* $9\frac{30}{121}$*d.*
16. 7*s.* $10\frac{1}{2}$*d.*
17. 1 mil. = $54\frac{87}{172}$*d.*
18. £29 8*s.* $3\frac{17}{28}$*d.*
19. £1716 8*s.* $0\frac{32}{63}$*d.*
20. 27951 : 12500.

CIX.

1. Nitre, 9 cwt. 2 qr. 7 lbs.
   Charcoal, 1 cwt. 3 qrs. $18\frac{1}{5}$ lbs.
   Sulphur, 1 cwt. 1 qr. $2\frac{4}{5}$ lbs.
2. $\frac{439}{443}$.
3. 1.
4. $1\frac{1}{14}$,
   $1\cdot0\dot{7}1428\dot{5}$.
5. 4·275 lbs.
6. $2\frac{3}{17}$.
7. £9 7*s.* 6*d.*
8. $\frac{47}{510}$.
9. $5\frac{1}{2}$.
10. $927\frac{73}{126}$ lbs.
11. $8\frac{1}{3}$.
12. $4\frac{16}{21}$ per cent.,
    $4\frac{16}{31}$ per cent.,
    or, 155 : 147.

CX.

1. 550.
2. 3556.
3. $8\frac{3}{124}$.
4. $44\cdot52\dot{4}9422\dot{1}$.
5. ·008075,
   $\frac{323}{40000}$.
6. 37196.
7. £75 18*s.* $9\frac{39}{215}$*d.*
8. 1057.
9. £1345 19*s.* 10·611*d.*
10. A, £63,
    B, £218 8*s.*,
    C, £138 12*s.*
11. £5 3*s.* $0\frac{15}{32}$*d.*
12. £91 7*s.*

CXI.

1. 1088.
2. $\frac{10}{391}$.
3. $\frac{99}{182}$, $\cdot5\dot{4}3956\dot{0}$.
4. 4 f. 7 po. 5·02 y.
5. ·0000032.
6. £3 11*s.* $11\frac{11}{173}$*d.*
7. 14838·18 s. ft.
8. £720.
9. $\frac{1}{4}$ gallon.
10. 120.
11. £37800.

CXII.

1. 14777328.
2. 47102207.
3. £18438777 9*s.* 11*d.*
4. £1977845 19*s.* $0\frac{3}{4}$*d.*
5. £255890 17*s.* $5\frac{1}{10}$*d.*

CXIII.

1. 121615999.
2. 13234044.
3. £88547383 12*s.* 9*d.*
4. 3627 days 16 h. 59 m.
5. £2532149 10*s.* $7\frac{9}{16}$*d.*

CXIV.

1. 113637783.
2. 34553826.
3. £4568319 18*s.* $4\frac{1}{4}$*d.*
4. £620553 14*s.* 2*d.*
5. £1234403 13*s.* $6\frac{5}{8}$*d.*

CXV.

1. 22.
2. £22240 19*s.* 4$\frac{1}{2}$*d.*
   £13 19*s.* 4$\frac{1}{4}$*d.*
3. £150 19*s.* 2$\frac{5}{8}$*d.*
4. 13$\frac{3}{125}$, 4$\frac{1009}{1170}$.
5. 7$\frac{1}{2}$, 1$\frac{1067}{1860}$.
6. 2·0272, 1$\frac{33}{320}$.
7. 24·51.
8. 23 tons 18 cwt. 2 qrs. 8 lbs.
9. 20 tons.

CXVI.

1. 100 a. 2 r. 37 p. 28$\frac{3}{4}$ sq. yds.
2. 1 dram 12$\frac{7}{8}$ grs.
3. 261 hhds. 6$\frac{22}{27}$ gals.
4. £12 11*s.* 10$\frac{1}{2}$*d.*
5. 15$\frac{17}{60}$, 21$\frac{3}{4}$, 6$\frac{104}{405}$.
6. £1 9*s.* 9*d.*
   £4660 17*s.* 9$\frac{7}{9}$*d.*
   $\cdot 08541\dot{6}$.
7. $\cdot 0\dot{5}$, ·0092857o5.
8. 12$\frac{186}{233}$ miles an hour.

CXVII.

1. £21 19*s.* 3$\frac{3}{4}$*d.*
2. 5 oz. 1 dr. 2 scr. 8$\frac{4}{7}$ grs.
3. 10$\frac{17}{72}$.
4. 4$\frac{3}{25}$.
5. 3$\frac{1}{2}$.
6. ·07504, 490000.
7. 11*s.* 3*d.*
8. 19 dwts. 9 grs.

CXVIII.

1. 71 lbs. 2 drs. 1 scr. 14 grs.
2. £300 16*s.*
3. 12*s.* 6*d.*
4. $\frac{15}{16}$.
5. 1$\frac{8}{11}$.
6. $\frac{2}{7}$.
7. ·0147, ·0025.
8. £1000 2*s.* 6*d.*
9. £18 4*s.* 7*d.*

CXIX.

1. 17 lbs. 5 oz. 5 drs. 5 grs.
   7*s.* 1$\frac{1}{2}$*d.*
2. 7.
3. $\frac{1}{3}$ day.
4. 7$\frac{1}{21}$, 103$\frac{25}{84}$.
5. ·013, ·375, $\cdot\dot{3}7\dot{2}$, $\frac{61}{800}$.
6. 31·64625, ·378, ·0225.
7. $\frac{1}{2}$.
8. £1 13*s.* 10$\frac{1}{2}$*d.*, 11 dwts. 6 grs., 5*s.* 9$\frac{3}{4}$*d.*
9. 29·8420664.

CXX.

1. 63693693630.
2. £16235 2*s.*
3. 80.
4. 33 cwt. 3 qrs. 21$\frac{3}{5}$ lbs.
5. $\frac{341}{720}$.
6. ·02, ·018.
7. £10 15*s.* 6$\frac{9}{10}$*d.*
8. £45 10*s.*
9. 17$\frac{13}{21}$ per cent., £546.

CXXI.

1. 80060002.
2. £1026161 1*s.*
3. £368704 10*s.*
4. 9$\frac{1949}{2520}$.
5. 12$\frac{76}{77}$.
6. ·4375.
7. £5 14*s.* 1$\frac{1}{2}$*d.*
8. 3892·857...
9. £10560.
10. 1 per cent.
11. £245 18*s.* 11$\frac{7}{9}$*d.*
12. 2880.
13. £138$\frac{8}{9}$, £236$\frac{1}{9}$.
14. 1512.
15. £196 13*s.* 6$\frac{3}{4}$*d.*
16. $\frac{7}{8}$.

CXXII.

1. 30001003.
2. £474178 12*s.* 6*d.*
3. £728700.
4. 1$\frac{17}{60}$.
5. 2040.
6. The former by $\frac{1}{12}$.
7. 34145.
8. 6$\frac{5}{6}$.
9. 8$\frac{1}{3}$.
10. 7*s.* 9$\frac{3}{4}$*d.*
11. £10.
12. 3$\frac{4}{11}$.

13. $3\frac{1}{8}$.
14. 90·8.
15. £22 13*s*. $2\frac{3}{8}$*d*.
16. £150, £180,
    £240, £300.

CXXIII.

1. £48000.
2. £6.
3. 10*s*.
4. 24.
5. 1·84375.
6. $8\frac{4}{7}$.
7. 23317·8.
8. 9200.
9. $\cdot 0\dot{2}\dot{7}$.
10. 4 tons 6 cwt.
    2 qrs. 12 lbs.
11. £520.
12. 503, ·1123.

CXXIV.

1. 11.
2. £199 11*s*. $5\frac{1}{2}$*d*.
3. 14.
4. £19 18*s*.
5. 20.
6. $\frac{30}{67}$, £60.
7. $\frac{5}{9}$.
8. 11·7578125,
   £11757 16*s*. 3*d*.
9. $2\frac{7}{8}$.
10. $\cdot\dot{8}5714\dot{2}$, $\frac{13073}{16650}$.
11. 1250000000,
    3·6056.
12. 440 yards.

CXXV.

1. £451 9*s*. 3*d*.
2. 4*s*. 2*d*.
3. 33.
4. £31 7*s*.
5. 118800.
6. £5398 0*s*. $1\frac{1}{2}$*d*.
7. 168000.
8. ·6875.
9. $\frac{39}{110}$, 9 lbs. 2 oz.
   5 dwts. $1\frac{11}{39}$ grs.
10. $3\frac{1}{3}$.
11. 476, 48·5.

CXXVI.

1. £10 10*s*. 3*d*.
2. £10 12*s*. 11*d*.
3. 59400.
4. $\frac{29}{55}$, $\cdot 5\dot{2}\dot{7}$.
5. 3792.
6. 25·08.
7. ·0333.
8. £875 12*s*. 6*d*.
9. £658 3*s*. 4*d*.
10. 6·46, $\frac{139}{126}$.
11. $3\frac{1}{2}$.

CXXVII.

1. 103.
2. £115 18*s*.
3. 255.
4. £18 5*s*. $7\frac{1}{2}$*d*.
5. £81 0*s*. $3\frac{3}{79}$*d*.,
   $3\frac{89}{237}$ per cent.
6. £890 6*s*. 3*d*.
7. $7\frac{17}{40}$.
8. ·301024.
9. ·00421.
10. £10 6*s*. $7\frac{17}{37}$*d*.
11. ·16, 2·6457,
    ·00027151.
12. $7\frac{11}{27}$.

CXXVIII.

1. £35 18*s*. 8*d*.
2. £2 5*s*.
3. 11*s*. $0\frac{3}{4}$*d*.,
   ·345703125.
4. 3534.
5. 123000·4.
6. 2541.
7. 5 years.
8. 23·281.

CXXIX.

1. £5406 5*s*.
2. 37 oz.
3. 3150,
   6 ro. 1 po. 15 y.
   3 ft. 28 in.
4. 10*s*. $4\frac{3}{4}$*d*.
5. $58\frac{3}{4}$ yds.
6. £1980 13*s*. $1\frac{1}{2}$*d*.
7. 18 miles.
8. $13\frac{3}{5}$.
9. $1\frac{1}{3}$.
10. 5·1875.
11. 7118580.
12. 8·75.

CXXX.

1. 933 tons 9 cwt.
   2 qrs. 1 lb.
2. 11 mi. 7 f. 39 po.
   2 y. 1 ft. 9 in.

3. 10 gals.
4. £124 12*s.* 10$\frac{1}{2}$*d.*
5. 45 miles.
6. £5 17*s.* 11$\frac{5}{48}$*d.*
7. 3$\frac{31}{42}$.
8. £3 4*s.* 2$\frac{1}{4}$*d.*
9. ·375.
10. 5 lbs. 4 oz.
11. 7360.
12. $\frac{85}{198}$, $\frac{3}{80}$.

CXXXI.

1. 54049600015.
   Fifty thousand and six hundred and three millions three thousand four hundred and one.
2. 15344, 25800, 54 tons.
3. 37.
4. 15.
5. $\frac{210,336,441,252,210}{1134}$.
6. 10$\frac{5}{8}$.
7. $\frac{3036}{4019}$.
8. 10175.
9. ·00545, $\cdot 1\dot{0}\dot{3}$,
   $\frac{21}{4000}$, $\frac{73}{990}$.
10. £12 0*s.* 3$\frac{31}{32}$*d.*
11. £5 18*s.* 11$\frac{1}{7}$*d.*
12. 9$\frac{259}{342}$ hours.

CXXXII.

1. 20709001501.
   Six hundred thousand and seventy - five millions eighty thousand seven hundred and five.
2. 227178, 358,
   12 c. y. 1000 c. in.
3. 7956.
4. 4 tons 3 cwt.
   2 qrs. 11 lbs.
5. $\frac{7361}{10140}$.
6. 1$\frac{1}{23}$.
7. $\cdot 19\dot{5}\dot{4}$.
8. $\cdot\dot{1}4285\dot{7}$,
   $\cdot\dot{5}2380\dot{9}$, $\cdot 00\dot{9}7\dot{2}$,
   $\frac{817}{5000}$, $\frac{197}{333}$, $\frac{107}{110}$.
9. 4188·63.
10. 7*s.* 6·888*d.*
11. 149 yds. 8 in.,
    £33 11*s.* 6*d.*
12. £25 5*s.* 0$\frac{60}{379}$*d.*

CXXXIII.

1. 306495278.
2. 1364.
3. £104 5*s.*
4. 10*s.* 4$\frac{3}{4}$*d.*
5. 11.
6. 4217199.
7. £53 2*s.* 0$\frac{7}{8}$*d.*,
   4698.
8. 7$\frac{1}{5}$ days.
9. $\frac{11}{40}$, 1$\frac{1}{8}$, $\frac{1}{196}$.
10. ·00002, 628000,
    1·7395, ·821875.
11. £12 13*s.* 2$\frac{4}{7}$*d.*
12. 140, 170, 190.
13. 15$\frac{685}{1408}$.

CXXXIV.

1. 94760000 miles.
2. 8 m. 4 f. 10 po.
   4 yds. 1 ft. 1 in.,
   363 lbs. 11 oz.
   8 dwts. 6 grs.
3. 2 qrs. 1 lb.
4. 11 lbs. 7 oz.
   16 dwts.
5. £188 10*s.*
6. £524 13*s.* 9*d.*
7. 18.
8. 5 dwts. 3$\frac{518}{1869}$ gr.
9. $\frac{13}{15}$, 2$\frac{31}{42}$, 2.
10. ·012016, 286·5.
    100·032.
11. 52 sq.ft. 72 sq.in.
12. 12$\frac{66}{85}$*d.*

CXXXV.

1. 580 tons 10 cwt. 2 qrs.
2. 54748, 3732, 74 sq. yds. 4 ft. 63 in.
3. 800.
4. 31.
5. $4\frac{437}{2400}$.
6. 3*s.* $3\frac{1}{3}$*d.*
7. $\cdot 188\dot{4}9206\dot{3}$.
8. ·000653, 1·1.
9. £6 9*s.* $9\frac{27}{56}$*d.*
10. 17.
11. 96.
12. £640.

CXXXVI.

1. 211204766206.
2. £424514 15*s.* 10*d.*
3. 4417, 53.
4. $\frac{18}{29}$.
5. $4\frac{1}{2}$.
6. £2531 5*s.*
7. $1\cdot 5\dot{1}4823\dot{9}$, ·00276.
8. 3*s.* $7\frac{1}{8}$*d.*
9. $\cdot 0\dot{4}0\dot{7}$.
10. £113 5*s.* 9*d.*
11. £457579 7*s.* $4\frac{7}{11}$*d.*
12. £7 4*s.* $5\frac{3}{4}$*d.*

CXXXVII.

1. Twenty-two thousand nine hundred and ninety-five millions two hundred and fifty-two thousand eight hundred and six.
2. 212096, 201 bus. 2 pks.
3. 17659.
4. $\frac{78}{113}$.
5. $1\frac{1}{5}$, $\frac{3}{34}$.
6. $\frac{7}{60}$, £3 11*s.* 6*d.*
7. $18\cdot 208\dot{3}$, ·02957.
8. 12*s.* 9·63*d.*
9. £4 4*s.* $8\frac{8}{9}$*d.*
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